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ABSTRACT

Building on the findings of a survey of potential users and a descriptive review of five existing information networks, the present study represents an attempt to characterize several options for a voluntary confederation of participants in operating the National Environmental Data Referral Services (NEDRES) being developed by the Assessment and Information Services Center of the National Oceanic and Atmospheric Administration. Concepts from economic theory and general models of information service network configurations were used to help define and evaluate the major trade-off factors. Findings resulting from the examination of the five reference systems are reported, including a suggestion that the National Water Data Exchange can and should be emulated by NEDRES, although serving a more diversified clientele. These and other propositions were used to compare decentralized and centralized options. A hybrid arrangement was found to be favorable and cost effective, permitting users with intermittent needs and limited capabilities to get support from local service outlets, while users with more consistent and intensive needs could be encouraged to mobilize their capabilities toward a more independent and more economical mode of finding and accessing environmental data stores of value to them. (JN)

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Options for the Development of a Voluntary Network of Participants in the National Environmental Data Referral Service

Final Report

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PREFACE

The work reported here was done by a project team at The MAXIMA Corporation led by Mr. Mark Morein. Day-to-day supervision was provided by Mr. John Gracza and the narrative was produced by Mr. Jerry Kidd with support from the MAXIMA editorial and document production staff.

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EXECUTIVE SUMMARY

The National Environmental Satellite, Data, and Information Service (NESDIS) of the National Oceanic and Atmospheric Administration is developing the National Environmental Data Referral Service (NEDRES) in response to a national need to improve the awareness of and access to a broad range of environmental data files. In support of this developmental effort, a series of studies have been conducted that have included (1) a survey of prospective users that confirmed the need for a data-sharing capability and the willingness of users to pay a fee for such services (MAXIMA, b) and (2) a review of the organizational characteristics of five existing information service networks, (MAXIMA, a). The latter study focused on the lessons that could be learned, both positive and negative, relative to the configuration of the network and the means by which participants might be brought together in the form of a voluntary confederation.

The present report builds on the two previous studies in the direction of the evaluation of organizational features and the generation of configurational options that might be most suitable for the NEDRES network.

In addition to the ingredients provided by the two preceeding studies, the present work includes a review of some selected theoretical concepts from the field of economics and of some models of organizational arrangements that are prominent in the information service area. Lessons were also drawn from an analysis of an early operational prototype of the NEDRES system.

The analysis of the reference systems and the evaluation of the optimal configurations were structured by attending to nine functional areas, as follows:

- Structure and governance procedures
- Communication patterns and methods
- Legal agreements
- Policies for financial support
- User charges and cost recovery
- Operating procedures
- Publicity and user education and training

- Performance measures
- Benefits of network participation

Some of the key propositions that came out of the analysis are:

- The National Water Data Exchange (NAWDEX) is the most appropriate model for NEDRES but the model needs augmentation in the areas of network governance, procedures that will accommodate a wider diversity of user's subject interests, and ease of use.
- Prospective participants are not averse to undertaking formal obligations to support such systems and to conform to centrally imposed procedural guidelines.
- Standardization of practices and procedures is valued by participants, particularly when such standardization is linked to fairness in the sense of equality of treatment. However, the system should also possess the capability to adapt to individual needs. (Users tend to associate such a capability with a provision for one-on-one or face-to-face transactions.)
- Participants will willingly share valuable assets that they already own but are sensitive to the marginal costs of each transaction; fees must be correlated with value received.
- User training can be costly and an insidious drain on system capabilities; the extent of investment should be correlated to trainee level of involvement to achieve optimization of the return on such investments.
- A detailed plan for the operational configuration that is shared by those having developmental and managerial responsibilities is conducive to the achievement of an effective system even when major deviations from the plan are engendered during the developmental process.

When these and other lessons were compiled, it was possible to discern a major pattern along the general lines of a decentralized vs. a centralized network. The configurational options were labeled Option A and Option B where A might utilize as many as 160 local service outlets while B would provide direct services to all users from a single location.

In a direct competition between the two options, the decentralized arrangement was judged to be marginally superior. However, it was also possible to see that an integrated or hybrid arrangement might not only yield most of the advantages from both options, but would also support the solution of some residual deficiencies inherent in either option by itself. Specifically, it is recommended that the local service outlet

arrangement be pursued with emphasis on the assignment of user training and the formation of local user groups to such outlet organizations. Thus, for example, if training resources are allocated to users with the most intensive and consistent needs for environmental data, "graduates" would be given the option of conducting their own online searches of the NEDRES file and their own negotiations with holders of environmental data resources.

The crucial features of the hybrid arrangment can be summarized as follows:

- Participant influence on policies and practices would come primarily via a constituent assembly of representatives of the local service outlet organizations. An executive committee mechanism could be used to enhance the efficiency of the advisory function.

- Communication responsibilities would be shared between those responsible for the overall administration of NEDRES and the local service outlets. For example, newsletter material of broad interest would be provided by the central agency; but local variations in style, format, and event coverage would be encouraged.

- Legal agreements would be made between NEDRES administrators and local service outlet organizations, but the details of mutual commitment between such local service outlets and their constituencies of users and data holders would be a matter for local determination. Major users and data holders working directly with NEDRES administrators, however, would be encouraged to formalize that relationship by a memorandum of understanding in a manner similar to that used by NAWDEX.

- Financial support would be shared between NEDRES Central, the local service outlet organizations and users.

- User charges would be levied on a per-transaction basis. Heavy users working directly with the NEDRES file would be eligible for discount rates as would the organizations holding data that made such data accessable.

- Operational support to users for both the search and the physical access functions would be available at either the local service outlet or via a NEDRES Central office (or both) at the discretion of the user.

- User training would be delegated to the local service outlet organization.

- A cost-effectiveness--impact analysis mode of evaluation would be pursued that would include both objective performance and subjective acceptance criteria.

- Major savings in user access costs plus some potential cross fertilization among users and between users and data holders should accrue from an arrangement that broadly distributes the operational burden.

The hybrid concept is one which explicitly recognizes that some users will need access to the communal data resources only occasionally, and so will have little incentive to invest in learning search skills or in negotiating with holders. The local service outlets will be a boon to such users. Meanwhile, a smaller set of users (who often will be major holders of data) will have consistent and extensive needs. Such users will benefit by adopting a lower cost, more independent mode of operation available to them under the hybrid arrangement.

1.0 INTRODUCTION

The purpose of the present report is to assemble several sets of information that can bear on the advanced planning of the National Environmental Data Referral Service (NEDRES). The specific objective is to delineate the options available to planners with respect to the organizational features of a voluntary network for the participants in NEDRES operations. The conceptual framework adopted for the consideration of organizational options is based on nine factors, as follows:

- o Structure and governance procedures
- o Communications patterns and methods
- o Legal agreements
- o Policies for financial support
- o User charges and cost recovery
- o Operating procedures
- o Publicity and user education and training
- o Performance measures
- o Benefits of participation in the confederation

The major source of substantive information to fill-out these categories came from a prior study (MAXIMA, 1982a) of comparable organizations in the data referral service area. Other sources include reports on newly formed user groups related to online bibliographic services and the applications of micro-computers. Conceptual material from the theory of voluntary organizations was also employed.

1.1 Background

It has been apparent for several years (Murdock, 1978), that access to data is a significant problem for workers in the fields of environmental science and related technologies. The problem can be illustrated by a hypothetical case wherein a municipality has engaged an architectural and engineering firm to design a pyrolysis plant for solid

waste disposal. The specific design of the plant and its location could hinge on a set of environmental factors: the geomorphology of prospective sites, drainage patterns, macro- and micro-climatological factors, etc. It is unlikely that the full array of such necessary data could be found in one place. More likely, some of the data would be held by local government agencies, some by state agencies, some by regional academic institutions, some by federal agencies, and some by commercial firms. Discovering who holds what can be not merely burdensome, it could be virtually unfeasible within reasonable time and cost constraints. Moreover, arranging for access to such data once the holder has been identified can be an additional burden--one that could make the data cost more than they would be worth.

The above example focuses on the specific case of engineering application. The same problem, lack of access, obstructs the work of research scientists as well as engineers and, in fact, it can be more severe for scientists because of limited funds and the absence of an adequate supporting organization. The one advantage that scientists do have is their links to informal networks and the general high value assigned to collegial cooperation in the academic sector.

In any case, neither the planner, engineer/entrepreneur nor the research scientist is satisfied with present data access capabilities. In a recent symposium paper (Clark, 1982), the mounting volume and particularly the diversity of data resources are seen as barriers to efficient access. The end user simply cannot cope with the complexity. Both national and international data exchange programs are called for. However, it is also recognized that it is not complexity alone that prevents adequate access. Burk (1982a, 1982b) makes the point strongly that it is managerial factors that are the most difficult to surmount. He identifies 46 publicly accessible referral resources on geoscience topic areas in his article but points out that 37 of the 46 really deal exclusively with the report literature and not with numerical data files. The nine that do deal with data, as such, are either narrowly nationalistic or restricted in subject coverage, or both.

1.2 NEDRES Objectives

NEDRES is conceived to be a tool to cut through these barriers. Its main resource will be a comprehensive, descriptive inventory of data holdings that will include the identity of holders and specification of access procedures. A small staff at the Assessment and Information Services Center (AISC) will not only build the inventory and see to

its dissemination, but will keep it current and, most significantly, will serve as facilitators of access arrangements between potential users of environmental data and the holders of such data.

The net societal benefit that can be expected from such a service has at least two components. First, the service should reduce the aggregate cost of data acquisition while at the same time enhancing the effectiveness of projects and operations that can influence or be influenced by environmental conditions. Second, it offers the prospect of a broader amortization of the costs of data collection. Consequently, those organizations or institutions that routinely conduct empirical observations and compile such data may be encouraged to expand their commitment with respect to coverage, or the sophistication of their instrumentation, or both. Thus, a spreading-out of the cost burden could lead to more data, better quality data, or both.

The process of realizing such social benefits, however, will be complicated. Developmental challenges exist in areas that range from designing the ideal format for the representation of data holdings to the methodology for achieving an exhaustive census of holders. For meeting this latter challenge and others related to it, a major innovation has been proposed as part of the basic NEDRES plan. The idea involves the creation of a voluntary network or confederation of the participants—both data holders and users. Such a confederation would serve a variety of purposes including providing a reliable base for communication with the total community of environmental scientists and technologists.

The concept of such a confederation is not unprecedented. Students of political science have long recognized that each agency of government relates to a coherent constituency of its own. In some cases, such a constituency is organized in a formal manner. A prominent example is the National Security Industrial Association, an organization that provides a legitimatized meeting ground for defense suppliers and their governmental customers.

While the constituencies of government agencies can be conceived of as coherent bodies and can be organized at any level of formal structuring, it is rare that the agency in question takes the initiative in providing the structural framework. To do so generates a set of obligations for the sponsoring agency as well as some prospective benefits. In a sense, such an initiative puts a double burden on the sponsor. The agency must not only develop an effective service in the technical sense, but must also configure the framework for the confederation with the same level of care.

It could be asserted that the mechanisms of service delivery and the quality of the service output are entirely independent of any collective organization of participants; that, in effect, such a voluntary confederation would be something superimposed upon the more basic structure of the apparatus for service delivery. However, related experiences suggest that even though a structured constituency organization might not be an essential component of the total service delivery system, once such an organization is established, its viability will feed back into and influence the viability of the more basic service apparatus. In other words, the constituency organization can provide an adaptive capacity within the total system.

It is that concern for the built-in, adaptive feedback that provides the primary impetus for the present project. The goal is to be able to build a participant confederation that will work to enhance the performance of NEDRES. The more immediate objective is to provide the best conceptual base possible for the detailed planning and configuration of the confederation so that it will support the achievement of the goal from its earliest inception.

While achieving adaptive feedback is a primary impetus to the creation of a participant confederation, another source of impetus of nearly equal status comes from the advantages of sharing. It should be recalled that the core function of NEDRES is the sharing of data resources. The addition of the confederation to the service delivery apparatus will permit the sharing of burdens as well as resources. Such burdens include the costs of identifying holders, of negotiating access arrangements, and educating users. Ideally, some portion of these burdens can be distributed throughout the confederation so that the core functions do not get bogged down.

2.0 STUDY PROCEDURE

2.1 General Background

The development of a new information service and the configuration of its organizational components can be perceived to be a subset within the broader problem domain of advanced system design. The logic and procedures by which systems are designed are in a state of continuing evolution. For example, in the 1950s and 1960s, the preeminent strategy in system design was a "de novo" or "start-from-scratch" approach. In a sense, the presumption was that there were no truly relevant predecessor systems and that, in

any case, the influence of precedents would tend to constrict the imaginations of the designers. The best concrete instances are found in the space program where, indeed, it would be a hard stretch to find valid precedents.

More recently, the emphasis in advanced system design has shifted toward a more conservative approach with the emphasis on cost control, mistake avoidance, and incremental change. A much more detailed logic has been created for anticipating the consequences of each design choice (Ostrofsky, 1977). This logic is tightly linked to the process of extrapolation from present experience with similar systems. The present effort toward the development of the NEDRES reflects this contemporary logic.

2.2 Data Collection and Analysis Procedures

The key procedure element has been comparative analysis and the building blocks of the methodology are actual operating systems with which comparisons can be made. Ideally, three classes of comparison systems can be identified: the so-called base-case or predecessor system, a primary reference system, and a set of secondary reference systems.

There are three action elements in the methodology. First, the comparison systems are scrutinized for operational deficiencies with particular emphasis on the base-case. The obvious intent is to avoid the perpetuation of any past mistakes. Second, a trial configuration of the new system is assembled in the form of a symbolic model. Third, the model is "exercised" in the sense that scenario is followed that is intended to represent the system in action. For example, it is known in advance that one of the functions of the system is to identify data resource holders. The question the developer asks is: How will the configuration support or carry-out this function? Each step of the process of conducting a holder census is symbolically "rehearsed" within the trial configuration. Such a rehearsal establishes whether the configuration contains the full set of components to carry out the function and whether there are potential barriers or bottlenecks in the activity flow. If problems are found, the comparison systems can be re-examined as a potential source of solutions.

The steps are recursive in that solutions to problems constitute changes in the initial trial configuration which can, in turn, effect other functions. Thus, the configuration must be exercised and modified until it is certain that all the principle functions can be performed in an efficient way.

In the present instance, there was a predecessor system called ENDEX that could be used as the base-case. However, it should be noted that while components still exist and can probably be adopted for use in NEDRES, the ENDEX service has been shut down for over a year so that current operational assessments are not available.

A much richer experiential base exists with respect to the reference system requirement. As a first step in the present project, over ten information service networks were examined to find features that might serve as prototypes for NEDRES. Five of these networks were selected as the most relevant in the sense of providing features that could help guide the planning of the NEDRES participant confederation. The detailed descriptions of these predecessor networks are presented in the project report entitled, Descriptive Analysis of Selected Data Referral Networks (MAXIMA, op. cit.).

From these several systems examples, a number of lessons can be drawn--both positive and negative--pertaining to a range of concerns from overall governance arrangements to the techniques most widely used for interparticipant communication. However, only one candidate for the role of comprehensive prototype emerges from the set of five: the NAWDEX (National Water Data Exchange) system established by the United States Geological Survey in 1976. While centrally administered by a federal agency, those in charge have managed to minimize the distinctions between "service provider" and "customer." All participants have been induced to assume a high degree of responsibility for the viability of the service in the sense of its economic sustenance, its coverage of water data resources, simplification of access procedures, and quality control. As a program, it has accomplished a level of participant involvement in one data topic area (i.e., water resources) that NEDRES is intended to accomplish for a more varied topical set.

2.3 Conceptual Analyses

In addition to the empirical analyses based on actual operating systems, two lines of conceptual analysis were also pursued. One such conceptual route was to examine process and economic transaction models from disciplines other than information services development for possible relevant contribution to the resolution of design choices for NEDRES. The second conceptual route was to consider organizational models that have been historically linked with the provision of information services.

3.0 SUMMARY OF FINDINGS

3.1 Conceptual

3.1.1 Transaction Models

In the classic model of a free market transaction, the traditional focus is on supply, demand, and price. Analysis based on such models and extrapolation from them to the planning of systems such as NEDRES is tightly constrained, however, by the fact that traditional models assume that the product acquired by the buyer in the transaction is a tangible one.

Another (usually unstated) assumption in classical transaction models is that the relationship between buyer and seller is transitory or, at best, episodic. That is, in the basic model, there is no inherent justification to extend the relationship once the buyer has his/her goods and the seller has his/her money. However, such an assumption is not entirely valid now even when the exchange medium is tangible. For example, either implicit and explicit warranties are now the rule rather than the exception in most tangible-goods transactions and any such warranty commits the seller to a lengthy relationship with the buyer even if the relationship is tacit and never effectuated by any further direct communication.

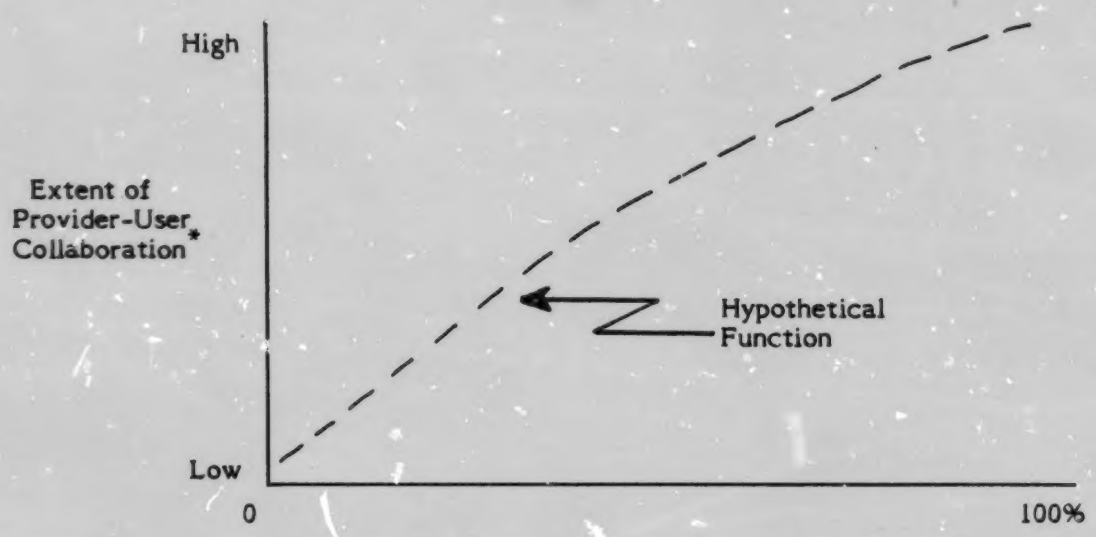
When the goods involved in the transaction are intangible (i.e., services), it can be hypothesized that there develops on the part of both the providers and the consumer a set of "shared interests" that relate to the transaction proper. The outcome can be a form of sustained collaboration between provider and consumer. Such a relationship is manifest in the continuity that exists in the relationship between a physician and a patient or between an attorney and a client. The shared interest appears to derive, in part, from the costs involved in building mutual understanding and confidence.

Such observations can be conceptualized in the form of an hypothesis to the effect that the more transactions involve intangible goods, the greater the degree of provider - customer (user) collaboration.

Exhibit 3-A illustrates the proposition in graphic form. The shift from competitive bargaining to collaborative negotiation is (hypothetically) a consequence of the movement toward a service economy and the increasing dominance of intangible "goods" in the exchange process.

Exhibit 3-A

Conceptual Base for a NEDRES Participant Confederation



* Measured by duration of transaction episode and the level of investment by all participants in the preexchange, exchange, and postexchange relationships.

Still another factor that could be relevant to the planning of the NEDRES confederation is that represented by the concept of a public or collective good. A collective good is one that accrues to all the members of a group by an intrinsic diffusion mechanism. For example, reducing the pollution in a lake would be a collective good in the sense that all lakeshore property owners would automatically benefit. If the lake were accessable to the general public for recreational purposes, the pollution reduction would be a public good.

Olson theorizes (Olson, M., 1971) that collaboration among group members to achieve collective goods is a negative function of the size and spread of the group. However, this negative effect can be overcome if selective incentives are added to the pot—so to speak—to specifically compensate those members of the group who absorb the costs of coordination.

If these hypotheses are valid, the summary implications are that some form of NEDRES user group (or groups) would come into being spontaneously whether authorized or sponsored by AISC or not. The relationship of such groups to NEDRES as the service provider or to one another could be varied and changeable unless consistency is established by some structuring of the arrangements.

3.1.2 Organizational Models

3.1.2.1 The Association Model

Workers in scientific and technical fields have a strong tradition of voluntary confederation and the mutual sharing of resources. The structures can be completely informal as represented by the so-called invisible college, or have complicated structures such as the American Chemical Society with its subject-oriented sections and its regional chapters. The NEDRES plan could incorporate a number of features from such associations. In particular, the effectiveness of such organizations in providing both professional and substantive information to members (i.e., the communication area) and in providing for continuing education (i.e., the user training area) constitutes a set of standards toward which NEDRES possibly should be aimed.

With respect to governance, there are also some useful features for considertaion. Specifically, association governance tends to be dualistic. On one side, there is usually some form of constituent assembly with an elected board and a president at the top. The board can and usually does function as a steering committee, and is empowered to pursue projects through both permanent committees and ad hoc sub-groups.

On the other side, there is usually some form of central secretariate headed by an executive who is explicitly an employee of the association. This secretariat nominally considers the routine, day-to-day business of the association including the production of journals and the provision of other information services.

Certain tensions with respect to authority are often generated by this dualistic arrangement. The president and the board have prerogatives based on the support of the membership while the executive officer has the greater intensity of involvement in association affairs and, usually, a higher level of managerial skills.

If the voluntary confederation of participants in NEDRES is formally organized with elected officials, while the central operations are conducted by salaried professionals, similar kinds of tensions could arise.

Another functional area of concern is that of financial support. The key ingredient in the association model is some version of membership dues. Such dues are often augmented by funds from subscription fees and revenues from annual conventions that come from exhibitors fees and attendance charges. Some associations have such profitable journals that dues can be kept minimal. However, recent general trends in dues increases have been linked to declines or zero-growth of association memberships. One problem appears to be related to the fact that there is little perceptual correlation at the level of the individual member between the amount of the dues levy and the amount or quality of the services provided. The survey of potential NEDRES users (MAXIMA, 1982 b) reveals that such a lack of relationship between the cost to the user and the magnitude of service is a sensitive issue for the scientists and technologists in the environmental studies area. The avoidance of situations where the correlation is not clearly positive also could be another aspect of the Olsen hypothesis (op. cit.) regarding collective goods and special incentives.

Finally, some consideration should be given to the factor of membership cohesion. Association members are bound together by common interests linked to their involvement in a single scientific or professional discipline. The participants in NEDRES will be quite heterogeneous with respect to discipline so that the binding force must come from some other source. In this regard, among others, the association model cannot provide a comprehensive blueprint for the NEDRES confederation.

3.1.2.2 The Consortium Model

Consortia are the established vehicle for interorganizational cooperation among libraries and other types of information service organizations. As in the association model, there exists a rich tradition of successes. Information service consortia generally manifest a high degree of generosity on the part of participants--an apparent willingness to contribute to the collective good with little or no special compensation. Thus, on the surface, consortia appear to represent some refutation of the Olson hypothesis. Careful examination reveals, however, that those consortia that survive their formative stage do provide special incentives as revealed in our case study of the Regional Medical Library

Network (MAXIMA, op. cit.). Specifically, the ten regional libraries that constitute the core of the consortium are reimbursed, in principle, for every inter-library loan transaction that exceeds the historic frequency of such transactions. In other words, the source of the collective good is rewarded for fulfilling that role.

The main lessons to be learned from consortia, however, came from the junction between stucture and governance, on one hand, and legal agreements on the other hand.

Possibly because of the good-will aspect mentioned above, consortia have been launched from time-to-time without much planning. In particular, governance arrangements have been ad hoc and committments of a contractual nature have often been lacking. When the arrangements are so casual, the degree of actual cooperation tends to decay. A recent incident that evolved from a consortium of ten academic libraries in south-central Minnesota reveals that when centralized management and formal agreements were introduced after a period of decline and decay, the negative trends were reversed.*

In the area of financial support, library consortia tend to be dependent on their parent institutions and where voluntary cooperation prevails, very little money changes hands. Therefore, even though NEDRES will be an information service and any participants are likely to have information services as part of their own operations so that it might appear that the consortium model might be entirely appropriate, the economic factor constitutes an incompatibility because the actual costs of NEDRES operations must be at least partially recovered.

3.1.2.3 The Consumer Group Model

As suggested in the discussion of economic models, many essentially commercial information transactions involve enduring relationships between provider/supplier and customer/consumer. Doctor-patient, lawyer-client, and teacher-student are among the classic examples, but the same characterization can be made with respect to the relationship between a publisher of a periodical and subscriber. In other words, it is a general characteristic of commercial information service relationships to be sustained over time.

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*The assertions are based on personal observation and verbal accounts from E. Johnson who was, at the time, Head Librarian at Hamline University, St. Paul, Minnesota.

This characteristic has, in a sense, washed back into areas of transaction that involve tangible products. In fact, its most pronounced manifestation is in the purchase of computers, particularly personal computers. In this case, the characteristic has been institutionalized in the form of permanent "user groups." These groups apparently reflect a sense of mutual obligation between seller and buyer that transcends most historical precedents. The mutuality is confirmed by the fact that the sellers now typically take an active role in the initial formation of the groups and then provide a subsidy in such forms as secretarial services, newsletter production, defrayment of costs of meetings, provision of training, and investment in the development of new products such as specialized software packages.

Oddly, in a major area of service transactions--online bibliographic services--similar user groups have formed, but without the participation of the sellers or vendors. In other words, paradoxically, where the permanence of the relationship is virtually imposed by the form of the transaction (i.e., subscription), the potential utility of mutuality between seller and buyer is mainly disregarded by the sellers (i.e., the vendors of online services).

The positive experience--cooperation rather than confrontation--registered by the computer user groups suggests that it is better for the seller/provider to become involved in the assembly and sustenance of buyer/user collectivities, rather than to have such groups emerge spontaneously in response to putative grievances. The next logical step is to suggest that if one were in the process of developing a new information service, particularly one that would operate in a commercial or quasi-commercial mode, one would be well advised to incorporate planning for such a user collective in with the planning for the technical and the organizational features of the new service. The potential relevance of such concepts and the actual experience in their implementation is being considered in the planning of the participant confederation for NEDRES as reflected by the present report.

3.2 Summary of Empirical Findings

3.2.1 Brief Review of the User Survey

The survey (MAXIMA, 1982b) confirmed a high level of potential demand for the kinds of services that NEDRES could and should provide. It also revealed that holders

are indeed prepared to share their data resources. However, the critical finding for present purposes was the diversity of the users. Their subject orientations vary, their organizational affiliations vary, their economic circumstances vary, and their specific data needs vary not only from person to person but over time for the same person. This condition puts a burden on the developers and managers of NEDRES to provide the capability to match these varied and changing needs.

3.2.2 The Base-Case Evaluation

ENDEX, the NEDRES predecessor system, ceased operation in 1980. As suggested above, little operational documentation exists. Consequently, there is some risk that the few elements about which there is tangible data, will receive more attention then they warrant. To counteract this trend, it is appropriate to begin with a listing of all the factors that may have contributed to the demise of ENDEX. These are as follows:

- Lack of awareness of the service on the part of potential users and sufficient resources to promote awareness
- Lack of proximity to service access sites due to the low number and particular geographic distribution of such sites
- Lack of user control or direct involvement in the file search process
- Lack of comprehensive coverage of data resources
- Lack of follow-up capabilities to aid users in achieving physical access to the data resources
- Lack of special incentives for data resource holders to compensate them for their efforts involved in making the data available to others
- Lack of adequate computer capacity--leading to transaction delays
- Lack of familiarity by users with information retrieval software used

As will be seen in the subsequent discussion, detailed critique is provided where concrete evidence is available and, more generally, specific provisions are recommended so that the NEDRES can avoid the listed pitfalls.

3.2.3 Reference System Analyses

To review, five reference systems were studied in detail:

- o The National Water Data Exchange (NAWDEX)
- o The Regional Medical Library (RML) Network
- o The Social Science Data Archives (SSDA) Network
- o The Online Computer Library Center, Inc. (OCLC)
- o The Canadian National Database for Geological Information (GEOSCAN)

Of the five, two are private sector operations (OCLC & SSDA Network) and three are run by national government agencies.

NAWDEX, the RML Network, and OCLC, are all highly successful systems. These systems have each served as models or prototypes for later developments on the scale of a global diffussion of innovations.

It is still too early to tell whether GEOSCAN will be viable or whether it will have a similar impact on information systems work.

The SSDA Network has been dissolved. While the precise reasons for its dissolution are not known, the conditions that were associated with its termination have been documented and some useful inferential lessons can be drawn.

All of the reference systems that were covered were at least national in scope (NAWDEX, RML Network) with GEOSCAN being national in scope for Canada and the Social Science Data Archives Network and OCLC having international links. All of these systems were constructed on a base of existing institutions and to a considerable degree, the network linkages were already in place and needed only to be formalized and solidified in order to become components of the larger organizational structure. For example, some traffic in document exchange between participating libraries was already taking place before the formation of the RML Network. The creation of a more formal structure by the National Library of Medicine permitted the Regional Medical Libraries to increase the volume of such traffic and to reach out to additional institutions that had not yet been involved in such transactions, but the main framework of the network was already in place. This circumstance is probably most important for international-level

arrangements. It seems likely that insofar as international reach is an objective in the NEDRES plan, the steps taken to achieve this objective should be oriented toward negotiations with existing organizations that already have strong constituency relationships with other bodies which contain both users and holders of environmental data files.

A related feature of the reference systems in the study set has to do with the degree of government agency involvement. While both NAWDEX and the RML Network are government administrated systems, the level of involvement is strikingly different. The government takes a dominant administrative-managerial role at the day-to-day operational level for NAWDEX but not for the RML Network. It is often forgotten that the RML Network was originally funded under grant arrangements rather than by contract. This initial arrangement reflects the fact that the NLM officials both desired and expected the Network to be self-governing. It was only after a growing collective perception that the arrangement lacked leadership initiatives that the funding arrangements were changed, and even then, a rather laissez faire management procedure was followed.

It appears that the precedent of a high degree of autonomy on the part of the Regional Medical Libraries was too strong to be shifted by the change in funding arrangements. The relative success of the RML Network in achieving its functional objectives suggests the conclusion that strong central managerial control is not essential to effective operations. It is also widely recognized that there is concern about the question of economic efficiency on the part of those involved in Network operations.

Ironically, both a highly successful and an unsuccessful system have had the least administrative influence from federal agencies (OCLC and the Social Science Data Archives Network). Both were partly subsidized by federal agencies during their formative stages, but were clearly aiming for a self-sustaining mode of operation in the long run. OCLC had the initial advantage of getting both money and instrumental resources (i.e., funds from the then U.S. Office of Education and the MARC-II tapes from the Library of Congress) from the government and additional funds from private philanthropy (i.e., the Ford Foundation's Council on Library Resources). The Social Science group was more dependent on dues from participants. It can only be speculative, but it seems possible that the member components of the Social Science Data Archives Network could confront the possible dissolution of the larger confederation with equanimity for two reasons: (1) each had succeeded in achieving near-peak levels of <u>regional</u> effectiveness prior to the formation of the national confederation, and (2) each could make an independent objective appraisal of the value-received for their dues contributions. In other

words, there was a quasi-commercial relationship between the member organizations and the confederation managers that could lead the members to terminate the relationship as soon as they perceived that the benefit-cost ratio was unfavorable. In a sense, OCLC is even more commercially oriented, but it is avowedly so with few remaining pretentions to academic collegiality as a binding force. Indeed, some participants have withdrawn from OCLC, but most "customers" appear to perceive that their own benefit-cost ratios are positive.

The inference that can be drawn from the analysis of the mode of funding and locus of managerial control is one that leans slightly in favor of some form of sustained managerial involvement on the part of the federal agency concerned and away from quasi-commercial arrangements.

The third general feature that needs to be mentioned is the matter of participant responsibility for the quality of the product. In this regard, it is the RML Network and the Social Science Data Archives Network that stand at opposite ends of the continuum. In RML Network transactions, there is not even the question of disavowal of responsibility. No participant would have the slightest expectation that there was any form of endorsement implicit in the fact that a document is delivered by an "agent" of an authoritative government institution. The mode is now and always has been caveat emptor in the exchange of documentary materials.

The Social Science Data Archives Network, on the other hand, had as one of its original and primary objectives the enhancement of the quality of the data provided to users and the protection of such users from "dirty" data. It seems probable that this focus was engendered by the fact that social science data is inherently more ambiguous than data from other disciplines. Possibly even closer to the point is that the purpose of the initial data collector was often purely commercial—not scientific, while the secondary users were avowedly scientific. Thus, the original collectors were not under canons of rigor. In any case, the Network group was at some pains to push standards for collection methods, coding procedures, etc., and the various member organizations, such as the Roper Center at Yale, continue to act to purge "bad" data and to educate their users on methods to extract only the good parts from files having mixed quality.

Since neither AISC nor NEDRES will be data file holders, the NEDRES staff will be, in a sense, parties to data exchange transactions in which they, the NEDRES staff, will never see or handle the actual materials. Under these circumstances, it would

appear to be a most reasonable policy for NEDRES to publicly disavow any responsibility for data quality. This is perhaps a minor point if the data are inherently of higher quality as they should be given the subject matter, the nature of the organizations doing the data collection (i.e., preponderantly government organizations), and built-in quality control mechanisms.* However, no data system can be completely error free and (as reported in the preceding volume) the Laboratory Animal Data Base, which was once provided by the NLM via MEDLINE, foundered and was abandoned because of criticisms of data quality. To an outside observer, there was some possibility that an otherwise excellent service was cancelled because of some minor flaws that would have been correctable by low-cost adjustments. The point is that it is possible to break your neck by stumbling over a pebble, and in the case of NEDRES there is no reason for the pebble to be there.

These are not the only lessons that can be drawn from the description of the reference systems. Others come out in the discussion of the functional areas that follows.

3.2.3.1 Structure and Governance

All of the Network organizations designated as reference systems share the same basic organizational structure which is a form of a multi-ring star pattern. The main structural variants are in the number of rings in the star, the span of numbers of component organizations in each ring, and whether or not the central rings or the central node is in a hierarchical relationship to the outer rings.

The archetypical arrangement is illustrated in Exhibit 3-B. The arm marked with the numeral I is characteristic of the RML Network. The central box represents the NLM; the next ring is composed of the Regional Libraries (10 at present); the next is composed of the so-called Resource Libraries; the next is the Service Units; and the final ring is composed of users. Of course, each ring element in the RML Network has its own set of users that are not shown on the diagram. Likewise, there are collateral connections both within and across rings so that, for example, a Service Unit can go to other Service Units or to Resource Libraries other than the primary one. These links are not shown in order to avoid clutter.

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*It is a matter of negative feedback. For example, even a commercial firm--say one doing seismic soundings for petroleum exploration--could not survive long if their data were faulty. In such a case, one could probably say truthfully--if its good enough for a large oil company its good enough for a university geologist.

While the NAWDEX structure is also a star, it has only a core and two rings: the first ring is composed of the 60 Assistance Centers and the outer ring is made up of users.

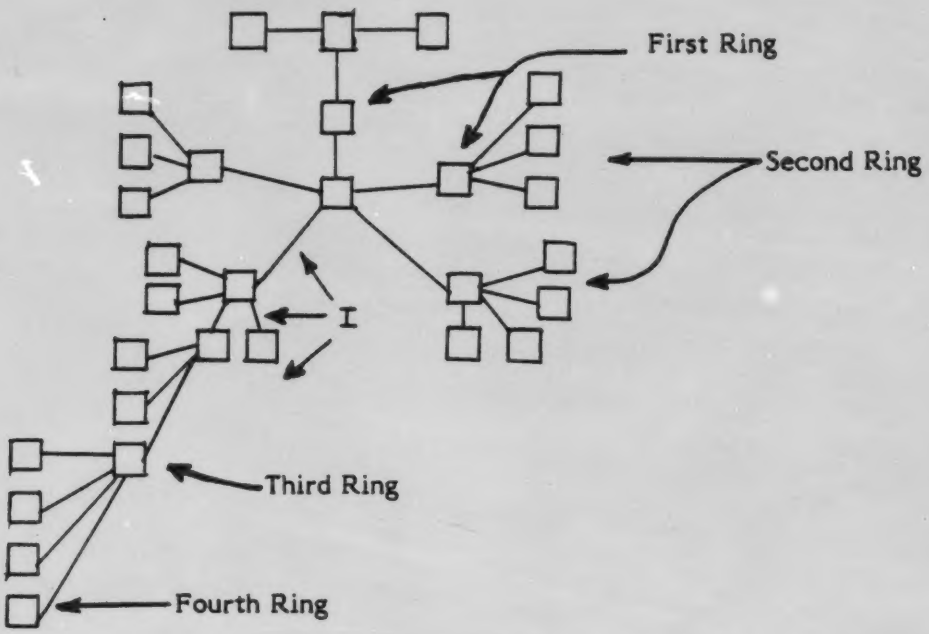
The Social Science Data Archives Network had a core and two rings also. The first ring was composed of twenty major archival centers, the next of users.

OCLC also has twenty regional centers in the first ring and 2,000 users in its outer ring. GEOSCAN is basically a smaller network having a first ring composed of ten centers and these centers work directly with users. However, GEOSCAN differentiates between professional users and lay users. The lay users are restricted to searching for data via one center, the Library of the Geological Survey of Canada. Therefore, all units in the first ring are not functionally equal; the LGSC has a special role.

The degree of hierarchy is the factor that connects structure to governance considerations. In this matter, it is clear that all of the organizations in the case studies were intended to be governed in a democratic, representational manner. However, there turns out to be many impairments to the realization of such a goal. Fundamentally, for example, the group or body that arranges for an organization to be brought into being is generally assigned prerogatives in the formulation of policy and the articulation of operational procedures. Ordinarily, such a leadership role assignment would be expected to be amplified when the founding body is a governmental agency because such agencies are universally hierarchical with decision-making responsibility and authority explicitly determined by rank. Consequently, it is highly ironic that the organization that appears to have achieved the greatest degree of authority delegation and participant influence on policies and practices is NAWDEX, the most "governmental" of the five cases. (Note: GEOSCAN, the Canadian Government's system, does not count for much in this topic area because its governance procedures are still evolving. However, its developmental history reveals that it too has been set up in such a way as to permit maximal influence on the part of prospective participants. Every attempt was made from the outset to achieve the idealistic goal of assembling a user-designed system (Batteke, et al., 1974). However, it remains to be seen whether or not the same level of idealism can be followed in practice once the system reaches full operational status.)

Exhibit 3-B

Archetypical Star-Type Network Structure



Indeed, the case studies can be read to suggest that the less bureaucratic and more "casual" the founding body, the more authoritarian the final configuration. The SSDA Network, for example, was founded by an ad hoc committee of a professional society in the context of an annual convention. Its final configuration was described by one commentator (Rose, 1974) as "elitist." OCLC was also founded by an ad hoc committee: one made up of academic librarians who constituted a component group of the Ohio College Association, a voluntary membership consortium that had no legal status before 1956, and no central secretariat until 1966. Yet OCLC has had the most controversial governance arrangements. It provided few mechanisms for participant influence on policies and practices while it functioned as a collective between 1967 and 1981, and now, as a not-for-profit but quasi-commercial organization, its board of directors is dominated by its ex-officio members.

The problems with the governance of the RML network have been alluded to previously. The initial concept of a self-governing arrangement has eroded even though the founding group has never had either the inclination or the capability to exert authoritarian influence.

In summary, if the goal is to achieve an arrangement whereby all participants have the opportunity (if not the inclination) to influence the policies and practices of the organization as a whole, the best reference model is NAWDEX. However, for reasons that will emerge later in the discussion, the planning principle for NEDRES probably should be to use NAWDEX as a baseline case and strive to take the distribution of governance authority one or two steps further.

3.2.3.2 Communication Patterns and Methods

The networks that have been examined are not distinguishable from other relatively large organizations in terms of the availability of communication modes and channels. Almost all conceivable options are available and almost all are used to some extent. At what might be called the engineering level, the number of optional modes is large. However, the whole universe of such options can be characterized in synoptic form as in Exhibit 3-C. This paradigm can be useful to us both for recapitulating the communications practices followed by the reference networks and for exploring, later on, possible innovations for NEDRES.

Exhibit 3-C

OPTIONAL INTRA-NETWORK COMMUNICATIONS MODES

Patterns	Methods			
	Face-to-face	Mediated		
		Real-Time	Stored	Mixed
Bilateral or Restricted	(Private Conversation)	(Telephone)	(Letter)	(Telefax)
Multilateral or Open	(Committee Meeting)	(Teleconference)	(Newsletter)	(Computer-Conference)

The paradigm conveys directly the extent to which organization communications can and should be concentrated in the multilateral or open category under Patterns. Within each of the cells of the matrix, a common example is provided in parenthesis. We

find the newsletter mode as an example of communications that are multilateral or open in pattern and mediated, using a stored message, as method. This locus is important because, looking across the five cases studied, the standard mode of communication appears to be the newsletter. The adoption of this mode appears to have taken place once the number of participants reaches the three-digit level. During the formative stages, participant communication is generally ad hoc, ad lib, and informal; punctuated by semiformal conclaves.

Even the newsletter mode, however, is susceptable to some variation. For example, in the NAWDEX case, the origination and dissemination of the newsletter is arranged centrally. In the RML Network case, each Regional Library prepares its own version for its own regional constituency.

Broadly speaking, the most notable feature of the communication activities of the five organizations is their mundane quality. This functional area does not seem to be a source of problems either to managers or rank-and-file participants and this may be the reason that little, if any, innovative enterprise is shown by any of the five organizations.

Consequently, it seems reasonable to assert that this area is unlikely to engender serious difficulties for those developing NEDRES. While it is not a matter that will "take care of itself," it does seem that some variations on the newsletter mode plus some form of periodic assembly is reasonably effective and not obtrusively costly.

Participant assemblies should probably take two forms. For a nation-wide or international scope of operations, the periodic assemblies might best be held bimonthly on a local or regional basis and annually for the whole of the participant membership. In the NEDRES case, coscheduling the large meeting with some discipline-oriented national professional society meeting might not be ideal because of the heterogeneous discipline representation among prospective NEDRES participants. Such arrangements, in other words, should probably be subordinate to other criteria such as convenience of time and place for the participant group as a whole.

3.2.3.3 Legal or Operating Agreements

It is somewhat strange that for collectives that are nominally democratic and that are avowedly voluntary in nature, the best success appears to be associated with the use of rather firm, legalistic forms of membership agreements.

Some form of "contractual" committment on the part of participants is characteristic of all the organizations studied with the exception of GEOSCAN, which has not yet reached the level of development where such an instrument would be appropriate. However, in the cases of the RML Network and the SSDA Network, such agreements do not (or did not) extend to the level of the end user. In the case of the SSDA Network, the contractual obligation was one between the regional centers and, in effect, the central secretariat function was a result of this agreement. The actual procedures for delivery of data services to individual clients of the local or regional level were not perceived to be a matter that should be standardized by a formal agreement.

Likewise, in the case of the RML Networks, formal agreements exist between the federal agency (The National Library of Medicine) and the Regional Libraries, and can exist between the Regional Libraries and the Resource Libraries but any form of binding committment below that level (i.e., between Resource Libraries and Service Units or between Service Units and end users) is completely optional and not a matter of apparent concern to the sponsors. The great number of participants and the variability of circumstances at the service unit/ end-user level would probably make it unrealistic to even attempt to bind the whole constituency together by legalistic means.

In the case of OCLC, the end users are institutions, not individuals. Consequently, it has been possible to establish a contractual framework throughout the network. The basic and standardized legal committment is the one between OCLC, Inc. and its twenty regional clients. Strong guidance is provided by OCLC on how the regional centers should arrange the legal committment on the part of their institutional subclients in the form of a standardized Participation Agreement. In summary, the end user (a particular library) enters into a service contract with a regional organization and the regional organization is party to its own contract with OCLC, Inc.

NAWDEX displays a pattern all its own. While it has its own regional centers, the crucial contractual arrangement bypasses these centers in the sense that each end-user organization makes its committment directly with the NAWDEX Program Office at the United States Geological Survey (USGS). Not only is the committment direct, it is also two-tiered. The first tier is a Memorandum of Understanding that defines the basic obligations of the parties to one another with particular emphasis on the member's obligation to provide access to their data holdings in response to other members' queries. The second tier is called the Memorandum of Agreement. It is somewhat redundant with the Memorandum of Understanding, but the focus is more on the procedures for online

utilization of the Directory and Index files of NAWDEX and the WATSTORE file. The particular precision reflected by this second instrument appears to be a consequence of the fact that online access involves the Computer Center Division of USGS as host and so the NAWDEX Program Office is at pains to ensure that its constituency follows the utilization procedures imposed by the Computer Center Division.

The summary inferences that can be drawn from observations of these reference systems are somewhat surprising. That is, there is apparently no serious reluctance on the part of voluntary participants to enter into rather firm legal committments as a condition of membership. Also, the effectiveness of the system appears to be correlated with the degree to which the obligational committment is extended to the end-user level.

The incongruity resides in the observation that the service transaction appears to work best when it is decentralized, but the legal committment works best when it is centralized. In summary, a form of duplex structure might be optimal with the central facility having direct bilateral dealings with end-user level participants in such functional areas as communications and contractual obligations, but using regional centers and thus an indirect mode for the provision of referral and support services.

3.2.3.4 Policies and Methods of Financial Support

It is useful at this point to distinguish between development and start-up costs as a distinct set compared to day-to-day operating costs. The means for meeting the latter costs will be covered in the next section; for the present, the focus is on the former.

All of the networks covered by the study had some support from federal sources during their formative stage. Likewise, all had some support from nonfederal sources--even those such as NAWDEX and the RML Network that could be called federal systems.

The two federal systems are more relevant to NEDRES in this regard, so the others will be noted only for contrast purposes. The key factor in the development of NAWDEX and the RML Network was the availability of an infrastructure of organizations that already manifested some level of service provision of the sort to be provided by the new system. So much has already been noted. What was not stressed above is the fact that the components of the infrastructure already had also a very significant resource analogous to capital goods. Specifically, in the case of the RML Network, the Regional Libraries and the Resource Libraries were selected for their roles in the new system on the

basis of their existing document holdings—particularly their collection of biomedical journals. The dollar value of such journal holdings at the typical Regional Library can be estimated as greater than $1,000,000 with annual increments in the neighborhood of $100,000. The system's aggregate holdings of documentory materials, upon which service provision depends, is certainly in excess of $100 million. In effect, the government could "lease" this resource and pay for its exploitation as a service ingredient for about $3 million per year.

The point to be drawn, is that while the government contribution of capital funds (and in the case of OCLC, capital goods) is essential to the establishment of new or greatly expanded services, the nongovernment participants do not come to the collective enterprise empty handed. The implication for NEDRES development is that start-up investment costs can be held to a minimum if a portion (the larger the better) of the resource provisioning responsibility can be delegated to key, nongovernmental participants. If, for example, the final NEDRES plan requires the involvement of some number of regional or local service centers, the organizations upon which such service centers will be based should be chosen in part because of their status as holders of numerical data resources, not because they are potential users or because they happen to be governmental organizations. It might be pushing the point too far, but it also might be beneficial if such key participants were also chosen on the basis of their ownership of computer resources.

3.2.3.5 User Charges and Cost Recovery

The practice of charging a fee for the use of a service is usually associated with the operations of a commercial enterprise. However, such practices are not the exclusive prerogative of the business community. There is also a broad range of transactions that are not strictly commercial where fees are imposed. The examples of the physician, the private lawyer, and the teacher as service providers have already been mentioned. It is also true that all levels of government engage in what might be called quasi-commercial practices. The parking meter fee is a mundane instance.

At the level of the federal government, such arrangements are often more complex and can have contradictory political overtones. Consequently, in 1959, an effort was undertaken to impose a consistent and simplified logic on federal practices. This effort resulted in OMB circular No. A-25, which continues to be the principal guide for federal

practices. It specifies that when "a service . . . provides special benefits . . . beyond those that accrue to the public at large, a charge should be imposed to recover the full cost . . . of rendering that service." Another key stipulation is that "fair market value should be obtained for the sale or lease of government owned propoerty." Reasonable provisions are included for excluding nonprofit institutions from fee liability and for avoiding situations where the cost of fee collection would be disproportionately high.

While there remain some political and ideological issues not completely resolved, there now exists a reasonable consensus for accepting the concept of cost recovery for information services provided by federal agencies. Indeed the current administration places considerable emphasis on user charges.

The main stresses surrounding the process at the operational level are linked to the timing of the imposition of charges and the use of charges to accomplish ends other than cost recovery. In regard to the latter practice, the intent is usually to discourage what have been called "frivolous" requests. For example, GEOSCAN imposes a $10 fee per request. This nominal charge is not linked to cost. Current plans call for a comprehensive review of the fee question when GEOSCAN reaches full-scale operations.

The timing factor comes into play because of the goal of the advocates of a given service to have that service achieve a high degree of user acceptance as quickly as possible. A free service is perceived by such advocates as having a better chance of capturing all its prospective users quickly, compared to a service for which a fee is charged. Most such advocates (given circular A-25 as a constraint) are willing to contemplate the gradual impositions of fees after the initial "user capture" is completed. How complicated this can become is illustrated by the evolution of the fee process in the RML Network case.

In the beginning, service to end users was free. However, the Network was, in a sense, victimized by its own success. Demand expanded far more rapidly then the support budget. Growing marginal costs were being carried by the Regional and Resource Libraries who had been led to expect to break even. To remain economically viable, there was no option but to ask the end user (or the end user's employer organization) to pay for each item delivered. The whole process is somewhat ironic because the initial intent had been to provide documents delivery services for those least able to arrange access such as students and workers in the allied health care fields.

In contrast, the private sector systems such as OCLC and the SSDA Networks were highly dependent on user fees from their beginnings. In fact, this leads to the consideration of the second subpattern. Both private sector systems had no capital base—no form of capital reserves. Consequently, both adopted a form of prepayment in the guise of membership dues. Also, it should be noted, the "members" were not individual end users but the organizations within which the end users worked. In the case of the SSDA Network, the "initiation" fee was relatively high and this might have been a factor in the ultimate demise of the SSDA Network. In any case, no government-operated system used this technique for cost recovery.

The noteable exclusion from both patterns is NAWDEX. NAWDEX has no initiation fee but has had a cost-linked fee per transaction from the outset. In fact, the most distinctive feature of the NAWDEX in this matter is the fine-grained differentiations made in the cost-fee connections. These differentiations are intended to engender fairness in the price to end users, making it not only proportionate to the cost to the provider but also commensurate with the benefits obtained. (NAWDEX also features a minimum charge in recognition of the fact that the expenses of collection should not exceed the amount collected.)

The only system in the reference group to achieve full cost recovery from user fees is OCLC. It is constrained to do so because no other significant source of revenue is available. The SSDA Network could not recover its full costs and when supplemental funding from federal sources declined, it was no longer viable. The government operated systems are all subsidized to some degree but the exact amount or proportion of cost recovery is not known (and is probably not knowable). The partial subsidy of end users by the government is justified on the basis of the public good achieved by information dissemination in areas of public interest such as health care and water resource management. However, based on the experience of the RML Network, there is a visible trend toward a proportionate reduction in the subsidy. Inferentially, the current rule appears to be that the greater the proportion of cost recoverable from end users the better.

3.2.3.6 Operating Procedures

In order to provide an integrated picture of operating procedures across the five reference systems, it is useful to adopt the end users' perspective on the sequence. From that perspective, the pretransaction condition is the recognition on the part of the end

user that a gap exists in his/her information resources and that filling the gap is essential if an immediate work goal is to be achieved.

The next step is a search for the specific information resources that will fill the gap. For all but one of the reference systems, the search step is a system function: the exception is the RML Network. Search services are not offered by the RML Network, as such, but are usually available through some other arrangements with the host organization (e.g., access to print indexes or such online search servcies as MEDLINE).

Among the remaining reference systems, another distinction comes into play: that is the degree to which the provider serves as agent or interlocutor in the search activity. For example, OCLC requires the end user to function entirely in a do-it-yourself mode. The SSDA Network approach was one in which the needed resource was identified by a manual search of inventory files by an employee of the service--sometimes with the end user as a direct participant and other times with the end user as a passive onlooker.

GEOSCAN provides mainly mediated machine search services. Again, however, NAWDEX provides the most relevant precedent by offering an option to the end user. Computerized searches of the inventory file can either be conducted independently by the end user or in a collaborative mode or in a mediated mode whereby a service center operative conducts the search on the basis of a structured request.

The next step is the actual delivery of the information resource. At this stage, the nature of the material delivered and the manner of delivery are inextricably intermixed. For example, what is delivered by OCLC is a non-numerical record (i.e., a complete catalog entry) and delivery is made via the same computer terminal by which the search was initiated. In contrast, the RML Network delivers conventional printed documents--piecemeal or in sets--in full text form after a delay of hours or days.

The product from the SSDA Network, GEOSCAN, and NAWDEX can be most simply envisaged as a reel of magnetic tape containing numerical data. In the SSDA Network case, these data recordings were drawn from the Network's own holdings. In GEOSCAN and particularly in NAWDEX, these files are mainly held "outside" the system and a second level of mediation can come into play in that an employee of the service can act to mediate the delivery transaction by endorsing the legitimacy of the user's work or by providing other reassurances to the holder. However, the end users can also ask for him/herself if they understand the delivery procedures which may be unique to the holder in question.

The implications from these referential experiences for NEDRES seem clear: variability in end-user needs and capabilities make it a positive virtue to be able to provide a wide range of possible degrees of participation in both the search and the delivery stages of the operational procedure.

3.2.3.7 Publicity, Promotion, and User Training

Most of the reference systems are not effectively advertised. For some, specifically the RML Network, very rapid growth in demand level is seen as possibly having more negative than positive consequences. Indeed, the demand growth already experienced in the absence of systematic promotion efforts has carried some negative consequences in the sense of enlarging costs more rapidly than revenues. However, the signal danger is usually perceived to be the possibility of severe overload on capacity and it has been that threat that apparently has kept promotion at a low-key level for all the reference systems.

Low-key promotion is also widely seen as being commensurate with the value system of academia--the institutional environment of several of the systems. Even OCLC, which is now thoroughly commerical and which has been upgrading its promotional effort, grew into a successful system on the basis, mainly, of word-of-mouth promotion within the relatively tightly knit community of academic librarianship.

The possible exception to this general characterization is NAWDEX which was much more actively promoted but still to a degree far below what would be undertaken in a true commerical enterprise.

NEDRES is in a position that appears to require at least a level of promotional effort comparable to that undertaken by the NAWDEX staff because the NEDRES constituency is more diversified both in topical interest and in institutional form than either the NAWDEX constituency or any of the constituencies of the other systems. Such diversity undermines the word-of-mouth promotion that takes place in homogeneous groups.

Among the reference systems, the one that has made the heaviest investment in user training is the SSDA Network. Part of that committment probably derives from the fact that the SSDA Network managers were all practicing teachers and another part probably derives from the relative difficulty in working with the social science data. In

other words, users had to be trained to some degree in order to have any secondary use of the data at all.

At the other extreme, the RML Network has spent virtually nothing on end-user training—understandably because use requires little in the way of special skill. However, training was not and is not absent from the RML Network agenda. The training effort expended has, however, been aimed at the service providers at the periphery of the network. Special instructional materials and some "hands-on" teaching were and are provided to operative personnel at the service unit level.

The other reference systems rely mainly on instructional materials that are intended to support user self-training. NAWDEX augments such materials with some workshop-style conferences where they can reach sizeable groups of users with a few presentations, but still get the personal interaction that is lacking in a program that depends exclusively on printed instructions.

One of the conclusions that emerges from an across-systems look is that user training can be a very costly enterprise. If the conjecture that most NEDRES users will be on-again/off-again clients, a heavy investment in end-user training does not seem to be justifiable. Probably users should be made aware of the elementary contact procedures and be given materials to support self-instruction but the best skill repository is probably the in-system providers of service.

Commercial advertising agency people have convinced themselves that their function is partly, if not mostly, educational. While self-serving in context, the concept is adoptable. In short, the posture adopted by NEDRES could be to combine promotion and training. All contacts, whether via printed materials such as brochures or face-to-face at conferences, should probably convey the two messages: (a) NEDRES can do this for you, and (b) here is what you can do to effectuate the service.

3.2.3.8 Performance Measures

Few of the reference systems have instituted formal, structural performance assessment programs. Growth in user-demand levels is usually taken as the key indicator; even by the RML Network where demand growth is perceived as a mixed blessing. One reason for the general disregard for peformance assessment is the cost of doing it well, and another is the high degree of subjective judgment that is associated with available performance criteria.

In one sense, the poor status of performance assessment sets up an opportunity for the NEDRES managers to break some new ground. One approach would be to track the ultimate outcome of a data acquisition transaction in the user's work output for a sample of users. Some objective index of impact might be created if users were encouraged to cite the data sources in their written products. In any case, some uncommon effort toward detecting user dissatisfactions and collating these reports in some structured way seems needed.

3.2.3.9 Benefits for Network Participants

This is another area that is apparently taken for granted by the managers of the five reference systems. In the NEDRES case, one could also argue that access to other people's data is what the users (in concert) say they want and that is just what NEDRES provides. However, the argument with respect to benefits can and should be made on a more analytical basis. If benefit-cost comparisons are taken as the analytic framework, the benefit factor is, indeed, inherent in the value of the data obtained. While a dollar figure cannot be assigned to such a benefit factor, the relationship is susceptable to a form of quantitative analysis because the value is a constant. That is, the value of the data will be the same regardless of the means by which it is obtained. Thus, the net benefit (or improvement in the overall benefit-cost ratio) can come only by a relative reduction in the cost factor.

That such a reduction is projectable is easy to demonstrate. The first phase in such a demonstration is the recognition that data acquisition is at least a two-step process. Step one is the identification of the data file and the tentative assessment of the relevance of the contents thereof. Without NEDRES, such a step could be very costly with respect to the user's time.

The second step is taking physical possession of a copy of the data file. While any cost figure would be pure speculation, the crucial parameter is that the holder would have complete control over the transaction; the user could exercise no cost control short of foregoing acquisition of the data file. NEDRES would provide some balance in any negotiations between user and holder by the very fact that both parties would share membership in the confederation, and by other mechanisms as well (e.g., a form of witnessing any attempt to exploit the situation).

Beyond the specific cost reduction factor for the user, some of the byproducts of the transactions might be, or become, very significant. For example, users will be prone to explain to holders what applications they hope to make of the holder's data. In some instances, that may be a requirement for access. In any case, such a transaction should be educational for the holder--providing news of local technical developments if nothing else.

Similarly, contacts are likely between users who will sometimes represent widely variant disciplines. This could lead to some cross-discipline idea generation of benefit to all concerned including the public at large.

These suggestions lead, in turn, to the prospect that the NEDRES managers should consider devising some means to elicit reports of constructive incidents of this kind and for collating such reports so that in combination they would constitute a meaningful body of evidence on the benefit issue.

4.0 INTEGRATED ALTERNATIVES

One of the possible inferences to be drawn from the ENDEX operational experience is that user access is really not greatly facilitated if the number of service portals is left very low, if the geographic distribution of such service points is not very well correlated to the distribution of the total potential user population, and if the service is only narrowly publicized. The latter point is a particularly delicate one because the full implications accentuate the value ambiguities between activities that are linked to "pure" research and activities that are semicommercial in nature. For many scientists, promotional activities and scientific values are antithetical: i.e., one cannot promote something and remain objective at the same time. It can be argued, however, that a distinction needs to be made between support services for science and technology and the substance of research and development. The support services will not be fully utilized unless the prospective beneficiaries are aware that the services exist. Moreover, promotion is just one component in a wide array of activities that are crucial to the survival of support service operations. The main point is that if the NEDRES is to generate the level of utilization needed to justify its existance, and if it is to generate the level of revenue needed to defray a significant fraction of its operational costs, it must be managed in a way that includes adaptations of practices that have been proven in commercial applications. Designing it as a quasi-academic subsidy to pure research is not

only hypocritical but is likely to generate a kind of schizophrenia in the formulation of policy and procedures.

If the commitment can be made to a coherent approach based on commercial values and practices, the configurational options for the voluntary confederation become much less ambiguous. One basic precedent for the confederation is that of the so-called user group. In a very real sense, the confederation can be planned to incorporate the attributes of a consumers cooperative that have shown themselves to contribute to effective operation of commercial bibliographic search services and the sustenance of customer loyalty in the personal computer market.

This emphasis on the consumer group model as a major source of conceptual guidance does not mean, however, that the other models are devoid of constructive concepts that are transferable to the NEDRES development effort. Indeed, the reference systems that we have examined at such length are all concrete instances of one of the other conceptual models. Specifically, the organization of the SSDA Network incorporated many of the features of a discipline-based association while the other four reference systems either arose from consortia (i.e., OCLC and the RML Network) or adopted significant features from such a model (GEOSCAN and NAWDEX).

Based on the relative successes of the reference systems, one might infer that the association model should be disregarded. It is true that some practices of associations, such as a dependance on dues, are probably not appropriate for a system such as NEDRES. However, it is possible to be selective. For example, associations are probably most effective in carrying out the communication function: most operative associations were founded to perform just that function. This suggests that selective emulation in the communication area would be constructive. Furthermore, it suggests that regardless of how NEDRES is configured internally, it should seek external links with associations in the relevant disciplines as a means of augmenting its own internal communications activities. Specifically, it would serve all well if the appropriate associations were to publicize NEDRES as part of their normal procedures for the dissemination of news to their members.

The consortium model provides an even richer reservoir of adoptive practices. Several of these will be emphasized in the discussion that follows. However, the point can be illustrated by just reiterating the proposition that the bedrock of consortium operation is the process of resource sharing in ways intended to minimize costs to the

organizational participants. This basic feature is, of course, central also to the justification for NEDRES.

In summary, we can draw selectively from all three conceptual models. However, none of the models provides a complete configurational option. Moreover, our target has been to contrast just two such options. Fortunately, the residual ambiguities can be localized into two alternatives, the crucial delineator for which is the definition of membership. Succinctly, one option requires the differentiation of levels of membership and the other option does not. To minimize unintended connotation, the two alternatives will be labeled simply as Option A and Option B.

4.1 Structure and Governance

Option A, the multilevel option, would have the structure of a two-ring star. The first ring would consist of up to 160 local service centers. These centers would be based in institutions that have a strong environmental research capability and where much of the research funding support comes from the federal government through a variety of agencies (not exclusively NOAA).* These various research institutes are predominantly affiliated with colleges and universities and consequently have some level of built-in responsibility to aid research and environmentally related projects in their vicinity. These institutions also are likely to be both holders and intensive users of environmental data and to have at least minimal computer capabilities.

The second ring would consist of all other local users and holders. It probably should be noted at this point that the user survey results (MAXIMA, 1982b) provide a strong indication that many prospective users are of the intermittant type; that is, they need access to very specific numerical files every month or so, but not on a continuous basis. Similarly, the findings suggest that such users would prefer that any fees be levied on a per-use basis rather than a flat rate basis--probably in part because they are always uncertain about what their own future needs will be. Thus, the nature of this second ring

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*Using Gale's Research Center Directory (7th Edition) and the 1982 Supplement, it was determined that there are at least 160 active research institutes doing work in meteorology, oceanography, and other fields to be covered by NEDRES that have a permanent staff of five or more full-time research professionals. These centers are well distributed throughout the United States including Alaska, Hawaii, and Puerto Rico, with some heavier but not surprising concentrations in California and Florida.

always would be somewhat nebulous in the sense that some end users might generate a high rate of transaction for a brief period and then have no needs for a time while other end users picked up the pace.

The relationship with data holders could be similar in the sense that some holders might have extensive, current and valuable files while others might have only minor data resources. Likewise, some holders are likely to be readily amenable to rather open distribution of their data while others will have restrictions and legitimate covenants for access control. In some cases, the service centers might be willing to act as depository facilities and make a regular practice of accepting magnetic tape copies of data files from those holders having a policy of unrestricted access.

Option B, the single-level option, would look more akin to the Association model; all participants would be "members." The central NEDRES staff would transact with these members on an individual basis much as the central secretariat of American Geophysical Union works with the Union members. Both the pros and the cons can be confidently anticipated based on the experiences of such national (or international) associations. On the pro side, for example, there is no "middle-man" who might fail to relate effectively with the end users or who might garble communiques from the central secretariat to such end users. On the con side, there is the chronic problem of keeping contact with a large, mobile and heterogeneous group of individuals. While "membership" implies equality of status, the level of enthusiasm is certain to vary from member to member and from time to time for each individual.

The structural distinction between Option A and B leads directly to distinction in governance arrangements. In Option A, the number of "members" would be relatively small and made up of institutions rather than individuals. Probably the simplest and most effective governance arrangement would be to establish some form of Advisory Panel of institutional representatives. The composition of such a Panel could be determined by a form of plebiscite that would provide an aura of democracy. However, it is doubtful that the membership would actually fulfill the criterion of being an "informed electorate." Consequently, a more efficient and in the long run the more equitable arrangement might be to have the composition of the Panel determined by a rotation procedure where regional and subject-area interests could be kept in balance. The Panel would be "advisory" in the sense that the main functions of the Panel would be to provide corrective feedback on the quality of the resource base and service arrangements plus providing a politically potent channel to the NOAA and Commerce Department policy-making levels.

(A good model from the functional point of view is the Board of Regents of the National Library of Medicine.)

The governance pattern for Option B would be more complicated. Given the larger number of members, the appropriate governance arrangement might be more like a constituent assembly which, itself, might number more than 100 members. The format for selecting such representatives should probably be based on subject-area interests. Again, the Association model is informative. Individual members could be required to align themselves in Sections in the mode of the AAAS. Then representatives of each Section could be selected by direct ballot in a number proportional to Section size. The Constituent Assembly could then structure itself by way of standing committees, task groups, etc., as the situation required. An Executive Committee of the Assembly could serve the same functions as the Advisory Panel in Option A.

It should probably be noted as a caveat at this point that any governance arrangement carries certain inherent risks. Instigating the governance procedures can be interpreted as implying that some power is delegated to the governance apparatus. The question of what happens in the case of a disagreement between the constituency of members and the federal sponsor, should probably be confronted in advance. If the power delegation is not valid and is discerned as such by the constituency, a negative backlash is conceivable that could undermine the whole system. On the surface, Option B appears to be more susceptable to this threat than does Option A.

4.2 Communications Procedures

The two basic options also generate somewhat different patterns for providing communication back and forth between NEDRES and its users. In Option A, the process would fall naturally into a relatively decentralized mode. For example, each of the local service centers would produce its own newsletter--intermixing local coverage with national-level material fed in from the NEDRES central office staff. This arrangement would follow the pattern of the newsletter procedures used by the Regional Medical Library Network.

A major feature of Option A, however, is the favorable preconditions for the implementation of frequent local gatherings of end users. Such face-to-face, informal conclaves are allegedly the main source of participant cohesion in the user groups for commercial online services and the customer groups put together by the microcomputer

vendors that were mentioned previously. In Option A, each of the 160 or so local service centers could function as conveener (but, once having fulfilled that function should probably stand aside and let the end users organize themselves). A possible problem that grows from such an arrangement would be the mixed composition of such local groups in regard to their subject area interests and their institutional backgrounds. Such heterogeneity might be divisive, but it might also be a source of cross-fertilization.

At the national level, the emphasis would be put on the periodic meeting of the Advisory Panel. It is conceivable that a plenary session of representatives from all 160 member organizations could be useful—particularly during the formative stage—but economic considerations would surely discourage any extended involvement in national meetings by members, much less end users. The possibility of bringing sizeable bodies of end users together by means of adjunctive meetings tied to national conventions of various scientific and engineering societies might be a useful device, but would be even more appropriate for Option B.

The basic element in Option B communications procedures, however, would probably be a national newsletter. It is reasonable to assume that the total membership made up of end users under Option B would number in the 3-4,000 range. This figure would permit good economies of scale in the production of the newsletter and would be easily handled by a modest computerized address file.

The main form of conclave would be an annual or semiannual meeting of the Constituent Assembly which could either take the form of an independent meeting or be held in conjunction with other organization's conventions as suggested above.

4.3 Legal Agreements

Under Option A, member status would be virtually a contractual obligation and probably should be formalized as such. It should be recognized explicitly at this point that under Option A there would exist a form of mild coercion on the established (and federally subsidized) research institutions to become NEDRES service centers. No explicit contingency relationship between participation and federal support could be drawn and, in any case, such institutions would have at least a nominal press toward such forms of community service as part of their intrinsic value system.

To be entirely candid, the local service centers would function as marketing instruments as well as providers of NEDRES services. The real responsibilities of this dual role should be spelled out in an unambiguous way by a form of letter-of-agreement if not by a more elaborate legal contract.

Under Option A, the precise nature of the legal relationship between the local service provider and the end user could be left to be more ad lib once the primary link was formalized. In fact, because of the anticipated fluidity and unpredictability of service needs on the part of most end users, the secondary link should probably not be formalized at all in most cases. Some end users who might generate relatively heavy traffic might also wish to lock in a favorable status such as a volume discount but these details should be decided on a local level.

Under Option B, the precedent established by the NAWDEX arrangements provides an admirable model—a proven success. Thus, each member would be asked to affirm his or her (individual or corporate) commitment to collaborate in the development/refinement/expansion of the service. Whether one or (as in NAWDEX) two instruments of agreement would be optimal does not appear to be a crucial question. However, for those parties who would function as both holder-providers and users, a special instrument might be required to recognize their more burdensome role as source of actual data and to formally recognize whatever proprietary rights they might wish to impose. (Notice of any such restrictions should probably be incorporated in the corresponding entry in the NEDRES holdings file.)

4.4 Means of Financial Support; User Charges and Cost Recovery

There are four possible general mechanisms for revenue generation that involve payments by users. These mechanisms can be characterized as follows:

- Purchase charges for print-on-paper versions of the data-file inventory
- Connect-time fees or print-out fees for an on-line seach of the computerized inventory
- Membership dues
- Broker-fee shares from resource holders

There are many variations within each of the means. For example, the print-on-paper version of the inventory could be marketed on a direct-mail basis so that NEDRES could acquire all revenue so generated that was above the costs of physical production. To make the example concrete, it is not inconceivable that 3,000 copies of such an inventory could be sold at a gross return per copy in the $20 range which could generate a revenue of $60,000. Actual costs of production and distribution would probably be in the range of $10 per copy so a net return in the $30,000 range is a reasonable projection. (It should also be noted, however, that significant investment costs are hidden in such figures. Specifically, the costs of constructing the inventory from a survey of source file holders should be represented on a pro-rata basis if a comprehensive accounting effort were to be required.)

Similarly, the inventory would need to be brought up to date periodically—probably annually—and a charge could be levied for such products. Consequently, regular annual revenues on the order of $18,000 to $20,000 would be attainable.

Special editions of the inventory could also be marketed. For example, the main index could be subdivided by topic and, in effect, sold in sections. Likewise, some users will be interested only in data from a particular geographic area so special editions could be assembled that were organized on an area basis. The point is that once a comprehensive inventory is available in computer readable form, variant editions can be produced even for relatively small-sized markets, because production costs are low.

The revenue flow from connect-time fees or print-out fees are contingent on the condition that the computer-readable version of the inventory file will be made available through a commercial vendor. The typical arrangement by file producers with such vendors is a royalty provision. Taking into account typical connect-time charges (e.g., $50 to $100 per connect-hour), average search durations and the total size of the user market, royalty revenues could be in the domain of from $50,000 to $150,000 per year. The variations could come in utilization of discount arrangements. For example, holders of valuable source files who made such files readily available to other users might be rewarded for such practices by being given substantial discounts or even gratis connect-time privileges.

The variation of charging users only for the print-out file entries would have the advantage of apparent fairness to users. For example, if a search failed to uncover a relevant data resource, no charge would be made. A good middle ground might be to

impose a very low connect-time charge and rely mainly on such a print-out fee for the bulk of search service revenue.

The use of dues as a source of revenue is more problematic. While several of the reference systems employed a dues arrangement, namely OCLC and SSDA, such dues were implicit substitutes for fees for services. In other words, the "members" paid dues either as a means of capital investment in the establishment of the service, or as a means of compensation on a pro-rata basis for a share of the services provided. Presumably, it is more genteel to pay dues as opposed to paying a fee. In any case, none of the government-managed services among the reference systems used this device for revenue generation. If it were adopted by NEDRES, however, it is possible that dues could serve two purposes: (a) as a form of prepayment that would guarantee the subsequent provision of services at a discount and (b) as a constraint on frivolous use of the system. Operational dues could be the direct equivalent of a one-time charge for the access code to the computer-readable inventory file.

Finally, there will be some instances in which holders of valuable source data files will require monetary compensation for making such files available to "outside" users. In such cases, it could be feasible for the holder to share a part of such a fee with NEDRES inasmuch as the whole basis for the transaction would be provided by NEDRES. In short, NEDRES would act as a "broker" for such transactions and would qualify for a broker's fee. There were no useful precedents provided by the study of reference systems and there is no empirical basis for estimating the frequency or dollar value of such transactions. However, the results of the user survey provide some grounds for suggesting that the gross-dollar amount of such revenue would probably be relatively minor compared to the other sources such as online search royalties. On a guess-work basis, perhaps $2,000 to $3,000 per annum might be achieved by this means if it were implemented.

In summary, the most promising sources of revenue for NEDRES appear to be the equivalent of royalty income from either or both the sale of the print-on-paper version of the inventory file and connect-time charges for access to the computerized version of that file. The combined revenue from both sources could be in the area of from $100,000 to more than $200,000 per year.

The actual amount that would come into the AISC account would vary, however, depending on the configuration of the confederation of participants. Under Option A, for example, the total market for the print-on-paper version of the inventory might be

constricted. Potential end users would know that the local service center would have the inventory and thus, the end users would be able to trade-off the cost of owning their own copy against the inconvenience of using the copy held at the local service center. Under Option B, end users would have to make some rather cumbersome sharing arrangement to avoid the need to own their own copy of the inventory.

With respect to online searching, the same effect would be amplified. That is, under Option A, most searches would be mediated by the local service center. The service center would be billed for connect-time by the online vendor and they would pass such costs on to end users; perhaps adding a service fee on top of the connect-time costs. Under Option B, end users would be conducting their own searches and so would pay only connect-time costs. If it were the policy of NEDRES to minimize charges to end users, in the interests of encouraging high use rates, Option A would pose the choice of either adding to the user's costs or sacrificing a portion of the royalty from the commercial vendor as a way of keeping the connect-time charge as low as possible.

To summarize, the Option A arrangement creates a classic "middle-man" situation and consequently generates a drain on the revenue that otherwise would come from end users direct to NEDRES. The imposition of dues, or a broker fee arrangement, or both, would not ameliorate this revenue diversion but would only add more complications.

4.5 Publicity

Lack of adequate publicity is likely to have been a factor in the relatively low level of demand for services than was characteristic of ENDEX, the NEDRES predecessor system. If so, there is some justification for giving particular attention to this activity in the advanced planning for the new system.

Many of the features of a more adequate publicity program would apply equally to either Option A or Option B (or any other configuration). Consequently, it seems appropriate to begin this section with a broad overview before proceeding to those aspects of a program that would be associated with one of the options but not the other.

At the broad level, there are at least three possible formal modes of delivery and one informal mode.

The formal modes are as follows:

- o Brochures
- o Printed advertising
- o Demonstrations

The informal mode is simply word-of-mouth.

The brochure mode was apparently the main mode used to publicize ENDEX. It is not known how widely or by what procedures the ENDEX brochures were distributed so there are no compelling lessons to be learned from that experience. However, close examination of the ENDEX brochure, itself, can identify some possible weaknesses that are correctable. For example, the ENDEX brochure (NOAA/PA 74014, 1976-Rev.) describes both ENDEX and a bibliographic search service called OASIS in such a way as to create some ambiguity about whether there are two systems or some form of mixed or hybrid system. Likewise, the brochure does not give more than a very general description of the service-product outcome that could be expected by a user. The intellegibility of the discourse is good in the sense that the narrative is clear. However, it is not made very explicit about what a "data file" might contain or how one would actually access such a file once it was identified by an ENDEX search. The half-tone photos presented seem to show a user arranging to conduct a search. These photos are very ambiguous and do not even convey any particular human interest because the tentative user's face is not shown. The space (and cost) might better have been employed to show a sample of a typical data print-out or what a "detailed inventory of a large, commonly used file" might look like.

In short, it seems possible that a brochure could be devised for NEDRES that would be a somewhat better information vehicle for prospective users than the one for ENDEX.

The next question is how should such an improved brochure would be distributed. Professional promoters recognize that direct mail distribution is not very efficient in the sense of the low proportion of recipients by whom the substantive message is actually perceived. Even so, direct mail can be cost-effective because the cost per contact is also low. Moreover, cost-effectiveness can be enhanced by some selectivity in the choice of target audiences. In the case of NEDRES, the membership lists of the appropriate scientific and professional associations would be a useful base. Some such lists

provide supplementary information such as research specializations that could be used to refine the target set. A particularly important target set would be individuals identifiable as information "gate keepers" who would be in a position to retransmit the substance of the brochure to a large secondary audience. College and university faculty members in relevant departments and librarians in academic and research libraries would meet this criterion.

Printed advertising should also be targeted. The obvious vehicles would be the professional periodicals in each of the specialty fields that make up evironmental science and technology.

4.6 Operating Procedures and Training Functions

The operating procedures for the utilization of the computerized NEDRES catalog under both Options A and B can be succinctly described. Under Option A, the password or access code to the NEDRES holding file would be exclusively in the hands of the local service center while under Option B, all "members" would have their own (self-identifying) access code.

Under Option A, the members in the form of the local service centers would provide the computer terminal equipment that would permit online call-up of the NEDRES file for end users. Under Option B, the end users would be required to provide or obtain their own terminal facilities but this is probably a minor problem given the proliferation of such equipment now throughout the "sci-tech" community.

However, there will be more to NEDRES operations than just searching the file. To get a more complete picture of operating procedures, we need to look at the complete scenario of end-user activities and we must examine also the operational activities of the other participants. Thus, in a sense, NEDRES as a whole is composed of a set of operational functions which are divided among classes of participants. The overall set will not vary much across the two strategic alternatives, but the allocation of responsibility will so vary.

This overall set of operational functions can be summarized as follows:

1. Holder identification
2. Holder description (e.g., nature of organization)

3. Source (data) file identification
4. Source (data) file description (i.e., countent parameters)
5. Characterization of (holder-imposed) access procedures
6. File description aggregation--preparation of a composite inventory
7. Preparation of an index to the inventory
8. Identification of potential end users
9. Provision of end-user access to inventory files
10. Provision of end-user access to source (data) file(s)
11. Facilitation of data utilization by end user
12. Transaction outcome evaluation (including cost)
13. Initiate cost reduction/control adaptations
14. Initiate product/service quality enhancements

To carry out these basic operational functions, there are three or four kinds of participants depending on the configuration. Under Option A, there are four consisting of source file holders, source file end users, system administrators, and transaction facilitators. Under Option B the transaction facilitator, as a separate type of participant, drops out of the configuration.

The system administrator would have the primary responsibility for operational functions #1-7, particularly during the early stages of system operation. However, as the system begins to gather some momentum, such operational functions, such as holder identification, should become more distributed. For example, holders of numerical data files who are not initially identified, will hear about the system once it is providing services and many of these holders will probably step forward to identify themselves. Likewise, formulating the description of the data file and access procedures, will be more delegated to holders as the system matures.

A somewhat similar evolution will take place with respect to end-user identification access to file and data utilization. With growing experience, users will take more initiative and become more autonomous.

Under Option A, both these evolutionary trends would be amplified by the involvement of the local service center in the role of transaction facilitator. Specifically, for example, the operational function of identifying holders could be quickly delegated to the local center as could end-user identification.

Certain operational functions, such as file description aggregation (which would include updating once the service was underway) and indexing, are probably more economically accomplished in a centralized arrangement--i.e., by the system administrators. However, aside from these "resource maintenance" functions, economy would come from a wider distribution of responsibility. Under Option B, the delegation would be in one step from the central administrator to holders and users. Under Option A, the delegation would be in two steps; first from central to local, and then from local to the holders and end users.

The training issue comes strongly into the picture at this point because for some operational functions, training would be needed before delegation could be implemented. The prime example is represented by operational function #9, provision of end-user access to the inventory file. This is the classic online search mode if the inventory file is computerized--as will be the case for NEDRES. It is true that online search skills are now widely available, and that some prospective end users could go directly to a completely autonomous mode. However, it is also true that some end users would be virtually helpless unless provided with an expert intermediary to actively perform the search.

Under Option A, it is conceivable that the local service center staff in their roles as transaction facilitators would not only provide the intermediary serivce if so requested but could also offer the particular course of instruction that could permit end users to conduct their own searches. Similar training could also be provided under Option B by the central administrators but the benefit to cost factor would be different.

Operational functions #10 and #11 also generate similar problems. That is, some end users will have difficulties in negotiating access to the resource files on their own and some, strange as it may seem, will have difficulties in making optimum use of the data in the source files once they are acquired. In part, these difficulties derive from the fact that end users are often intermittant participants: it does not pay them to learn all the skills for so few transactions. With repsect to data utilization, it is also often the case that the original data coding or format are not entirely compatable with the user's system and that transformations of some kind are required. Again, the local service center under Option A would be in a position to either fill the expertise gap in a consultative mode or to provide a relatively intensive form of training.

To summarize, in part, there are approximately fourteen basic functions to be performed in the operation of NEDRES. The distribution of these functions among

participants tends to evolve over time such that all tend to be centralized early in the evolution of the system, but the peripheral participants gradually take on more and more responsibility as the system matures.

Option A appears to offer a possible advantage over Option B in this particular area because of the mediational capacity of the local service centers.

4.7 Performance Measures

From the viewpoint of the system's managers, the fundamental indicator of performance will be the level of demand as measured by the frequency of requests for service. This indicator cuts across the configurational alternatives. In fact, this condition remains true for all measures of effectiveness. The criteria are the same because the objectives are the same regardless of what configuration is adopted to meet the objectives.

However, this commonality of criteria does not mean that the options cannot be differentiated. As might be expected, planners and managers will be confronted by conflict between criteria. The trade-off that results from the attempt to resolve such conflicts varies between the two configurational alternatives.

Before considering the trade-off distinctions, we need first to explore the criterion domain a bit more extensively. The framework for such an exploration is a rough approximation of benefit-cost analysis.

Our exploration can begin with an elaboration of the demand factor. One question that arises is "what is the sufficiency level?" That is, is there a quantitative target that can be asserted on rational grounds that would justify the investment in NEDRES? Likewise, is there an optimum? Put another way, are there demand levels that are so high that the consequence is negative to the survival of the system? (It should be recalled that the RML Network experienced just such a problem. Moreover, it is a common concern among information service professionals that the casual sequence: intense promotion, high demand, overloaded capacity, low quality service, disaffected user, lost user, is valid.)

Another related complication relates to the rate of growth of demand. Here a trade-off appears. A high initial growth rate will verify the community need and could generate a useful flow of revenue. However, such growth spurts are hard to control and

could lead to capability swamp-outs, misaligned resources, and rapid fluctuations after the peak demand levels were reached.

Typical of information service operations in general, it is unlikely that the NEDRES will be able to successfully consumate all requests for service. In other words, some searches will yield nothing and some holdings identified by a search will not be as suitable to the user as hoped or will not be accessable to a particular user at all. Thus, the demand criterion needs to be tempered by some analytic indicator such as the proportion of successful utilizations. As just implied, several sub-versions of a "success-ratio" are conceivable--relative to when the acquisition sequence is terminated. Early terminations would be "good" in the sense of lower costs while later terminations would indicate that the search component of the system was working well.

This leads us to cost as a criterion. For present purposes, cost analysis can be restricted to system costs. At the simplest level, the criterion is to minimize system costs; but again, such a criterion is probably too simple. Cost to the system per transaction might be more meaningful and cost per successful transaction might be even more so. The prospect that there is a trade-off between cost to the system and cost to the user will be covered in the next section.

As we are beginning to see, demand rate and cost criteria can become fairly complicated--but both have the virtue of being measurable in relatively objective, quantitative ways. A related criterion is both deeper and less rigorous. It is connoted by the term "resilient."

The point is that experience suggests that systems such as NEDRES often do not function in a particularly stable environment. Political, technological, and economic factors can change quickly. Any indicator of resiliency would need to be a time-based measure. Actually, none exist that are entirely satisfactory but in the NEDRES case, a good approximation might be the rate at which the cost per successful transaction stabilized or returned to a "normal" level after some external perturbation.

Given this brief tour of the domain of performance criteria, we can turn now to the differentiations related to the configurational options. For immediate purposes, we can best express potential differentiations by a series of questions tied back to the criteria just elucidated; to wit:

- Which Option is likely to generate the most demand traffic?
- Which Option will produce the best growth pattern?
- Which Option will yield the best success ratio (completed transaction/ requests)?
- Which Option will generate the least cost per transaction?
- Which Option will be more "resilient?"

The trade-off factors show up clearly in response to the last question. In this regard, it seems reasonable to suggest that Option A would provide more diversity of component forms, each of which would be relatively autonomous. Thus, it would be reasonable that even if calamity struck one portion of the system, the remainder would have a good chance of survival and renewel. (For example, a local service center might be forced to close down for reasons completely unrelated to their NEDRES role. Given the potential geographic density, as many as 160 such local centers in the U.S., the adjacent outlets should be able to absorb the shift in demand without much disruption.) On the other hand, Option B would permit more direct control over user transactions. In an emergency, the system as a whole could be quickly reconfigured "for the duration" and just as quickly returned to its pre-emergency form.

4.8 Benefits of Participation in the Network

Under this category, the perspective adopted is that of the user--in other words, we are now concerned with the intended beneficiaries of the services to be provided by NEDRES.

As in the preceding analysis, the basic output, access to environmental data resources, will not vary across configurational options. To attempt to distinguish between options, another set of questions must be asked. The first is "do end users need something other than data access from NEDRES?"

Some answers come readily to mind. For example, the reduction of access costs to the user is a virtual certainty for most prospective users as demonstrated by the analysis of finding and physical acquisition costs described in Section 3.2.3.9. Any reduction in such costs improves the user's cost-benefit situation because the benefit factor is a constant.

Speed and convenience of access will also be improved for most data seeking episodes for most users. Moreover, convenience can be construed in this instance to include connotations of minimal bureaucratic procedures and an implicit recognition of the end user as a unique individual.

If these criteria are appropriate, the next question becomes "is one of the options more likely to generate these benefits than the other?"

In this matter, Option A appears to have a clear potential advantage because the service provider will be geographically closer to the end user--to the degree that face-to-face transactions should not only be possible, but should predominate in frequency.

It is conceivable that individualized attention could be given to end users under Option B if the central NEDRES staff were large enough. It is also conceivable that the local service center personnel could handle their transactions with end users in a highly bureaucratic manner. However, the face-to-face situation is likely to inhibit the latter mode of performance, but the critical factor is that under Option A, end users will have a back-up channel of appeal and complaint. That is, end users can appeal to the NEDRES center if they do not get good service at the local level. Again, such an appeal proviso could be incorporated in Option B, but it would not be as well linked to other end-user practices, experiences, and concepts, as it would be under Option A. Under Option B something like an ombudsman would be needed at NEDRES Central. Such a "remote control" arrangement is unlikely to be highly effective.

4.9 Summary Review

The overall comparison between Option A and Option B is provided in synoptic form below.

TABLE 1

Major Operational Characteristics of the Optional Configurations

Areas of Comparison	Modes of Implementation	
	Option A	Option B
1. Structure & Governance	Decentralized, two-ring star structure: advise and consent on policy and procedures via panel composed of representatives of local service outlets; feedback provided by local user groups attached to each outlet.	Centralized, one-ring star structure: advise and consent on policy and procedures via representative constituent assembly and (mainly) its executive committee; feedback also by direct, ad lib channels--user to NEDRES central.
2. Communications	Emphasis on face-to face interactions; user viz provider and user to user: locally edited newsletter augmented by materials from NEDRES Central.	Mainly written plus telephonic interactions: newsletter edited at NEDRES Central and produced on mass production basis.
3. Legal Arrangements	Explicit contractual commitment between NEDRES Central and local service outlets: form of obligational arrangement between local outlet and local user constituency on ad hoc basis.	Explicit contractual agreement between each individual user and data holder and NEDRES Central.
4. Financial Support	Both the costs of service provision (incl. user training and computer hardware) and most revenues (i.e., user fees) would be shared between NEDRES Central and local service outlets.	All operational (service and product fabrication) costs would be born by NEDRES Central but all revenues would also flow into NEDRES Central.
5. User Charges	User fees would be levied and collected at the time and place of the service transaction.	Users would pay on-line search charges to on-line vendor who would remit a royalty-type payment to NEDRES Central.

Table 1 (continued)

Areas of Comparison	Option A	Option B
6. Operating Procedures	Searches would be mediated—using expert searchers; user-searcher side-by-side mode would be feasable: transactions with holders would also be mediated at user's discretion.	User would function in do-it-yourself mode or with ad hoc support from user's own organization (e.g., the company or university library staff).
7. Promotion & Training	Emphasis on informal, word-of-mouth promotion: hands-on training in small group setting.	Emphasis on formal modes of promotion (e.g., direct mail brochures): training primarily self-instruction mode using centrally produced instructional aids.
8. Performance Measures	Provides means for direct experiential evaluation in the area of user problems/user satisfaction-dissatisfaction	Would probably require periodic user surveys but enhances measurement standardization and continuity for trend assessment.
9. Benefits of Network Participation	Reduced access cost plus collegial information exchange beyond data file sharing.	Reduced access costs only

5.0 COMBINING THE OPTIONS: A HYBRID MODEL

Having examined two contrasting organizational arrangements for a voluntary confederation of NEDRES participants and having seen that each provides some singular advantages, it becomes appropriate to consider the possibility of some form of reintegration or hybridization between the main options. Such a possibility can be affirmed if a differentiation between sub-classes of users is acceptable.

There is a rough rule-of-thumb in the operation of an information service that 80% of the demand traffic will come from 20% of the users. The NEDRES user survey (MAXIMA, b) findings reveal the prospect of a similar pattern specifically for NEDRES. Many information service operations, particularly large-scale, centralized systems, have problems with this demand pattern because of their need to achieve economies of scale by standardizing transactions. In the present case, this lopsided demand pattern can be turned into a net advantage.

The resultant hybrid concept is illustrated in Figure 3. As is apparent, transactions are permitted on both a local, mediated basis and by a more direct, do-it-yourself mode. Some highly sophisticated users will be able to operate directly on the database and such users and most holders will be able to interact directly with NEDRES Central from the outset. Others may start in the more dependant mode of working through the local service outlet until they build their own search skills or their transaction rate increases or both, whereupon they can "graduate" to the direct mode.

In the meantime, the user group sponsorship responsibility will remain with the local service outlet organization and all types of users and holders will be encouraged to be active members.

A possible line of criticism of the hybrid concept is that it makes distinctions among users that might be interpreted as invidious and that could lead to inequities in the level or quality of service to the various sub-sets of users. The basic rejoinder to such a criticism is that it is entirely speculative and that there are strong, built-in safeguards against inequitous arrangement in any such service that is under the overall administrative control of a federal agency.

While this rejoinder might be enough, it is useful to take a more positive stance in support of the hybrid concept. At a general level, it can be asserted that user differentiation is essential for the operation of any service that sets individualization as an objective. In effect, sub-set differentiation can be perceived as a way-station or as partial fulfillment of this objective.

On a more detailed level, the evidence accumulates that within the total user population there exist such profound differences in established modes of use of information of all kinds that if a system failed to adjust to these differences, it would exclude a major portion of its prospective clientele. This assertion is supported by the NEDRES user study (MAXIMA, op.cit.) and by a very recent study of the use of information resources by engineers in industrial and commercial settings (Shuchman, 1981). This latter study reveals that most access by such engineers to technical information in any form by any mode is mediated in some way. When the information is accessable via a relatively advanced mode such as a computer terminal, the level of mediation approaches 100%. While this finding has its ironies, it suggests strongly that unless mediational support is provided, NEDRES services will not be truly accessible to many of the engineers and technologists in the private, nonacademic sector of the total potential user population.

In any case, the overall picture of the hybrid version can be summarized, as was done before for Options A and B, in Table 2.

What can and should be stressed beyond the specific assertions contained in Table 2, is the aggregate economic advantage that the hybrid arrangement could yield. The overall picture shows not only a broad distribution of the burdens involved in providing the referral services but a distribution that comes very close to matching proportionate costs to proportionate benefits for all participants. The possibility of achieving efficiency, adaptive flexibility and a high quality of service is provided by the hybrid arrangement and we recommend that its implementation be pursued.

FIGURE 3

PARTIAL REPRESENTATION OF HYBRID NETWORK STRUCTURE

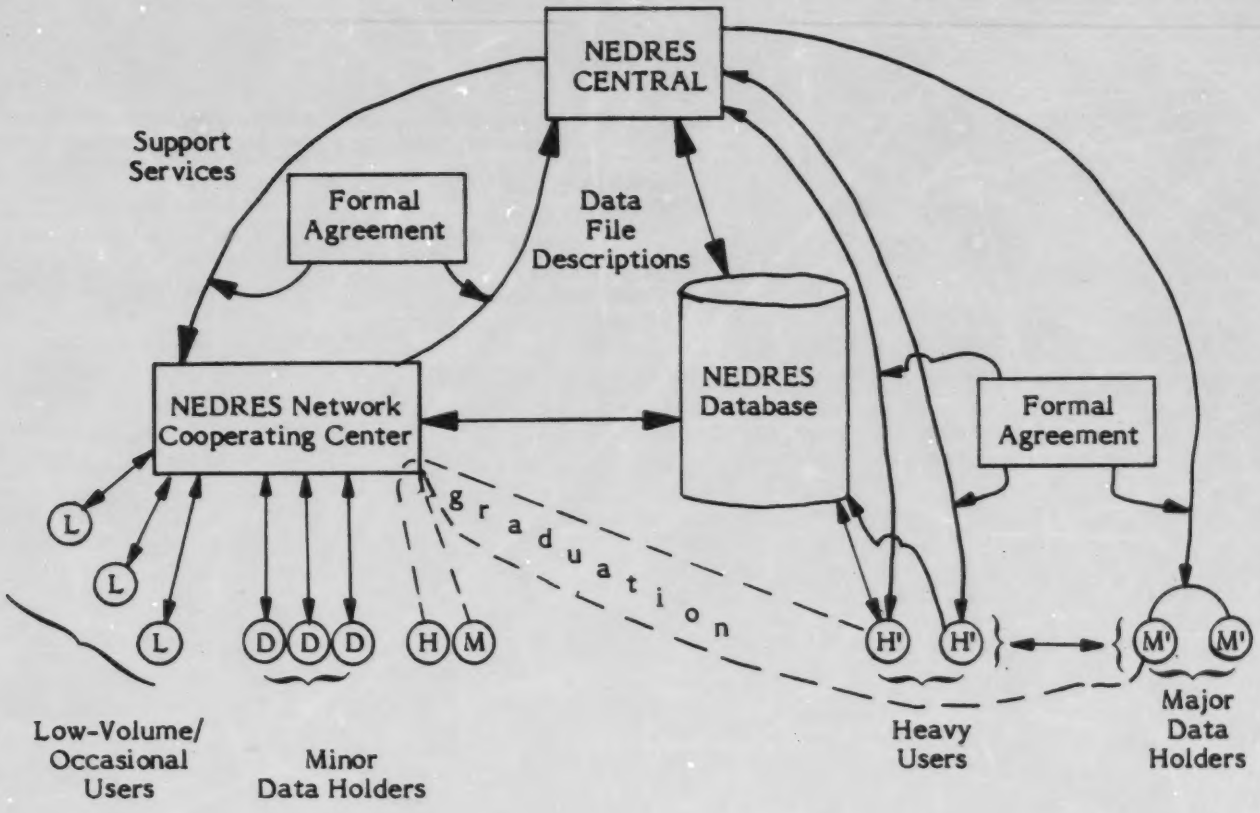

TABLE 2

Summary Features of a Hybrid Arrangement

Functional Areas	Modes of Implementation	Potential Advantages
1. Structure & Governance	System-wide governance would be a central function supported by an advisory panel of local service outlet representatives. Each local user group would be self-governing.	Dynamic accommodation to variation and changes in user/holder needs and capabilities.
2. Communications	In addition to local face-to-face communications, each service outlet would assemble a local newsletter augmented by material provided from the NEDRES central office.	Local/parochial interests would be paramount.
3. Legal Arrangements	Two lines of formal obligation would be implemented: those between the NEDRES central office and each local service outlet, and those between the NEDRES central office and principal data holders and those major users who will conduct their own file searches and access negotiations.	Intense users and key holders would be closely bound with the broader interests of NEDRES central office.
4. Financial Support	Local service outlets would share the costs and revenues of the provision of mediating services but NEDRES Central would receive all revenues from the heavier traffic from the independent users.	More flexibility in making arrangements such as in-kind compensation for important holders.
5. User Charges	Levied by local service outlet on per-transaction basis for mediated services and by on-line vendor for nonmediated access.	Higher proportional share of total revenue allocated to NEDRES central office with no proportional increase in cost burden.

TABLE 2 (cont.)

Summary Features of a Hybrid Arrangement

	Functional Areas	Modes of Implementation	Potential Advantages
6.	Operating Procedures	Local service outlet staff would serve as intermediaries for infrequent users or users having limited capabilities for both file search and access negotiation activities. Large scale users will have direct online access to the NEDRES file. All data holders will need to work with the central office staff to define access arrangements.	Minimal prospective failure rates; faster, cheaper service for heavier users.
7.	Promotion & Training	Individualized on as-needed basis.	High level of local sharing of burden but with outlay focused on high-need cases.
8.	Performance measures	Both spontaneous and rigorously structured modes can be implemented.	Yields more complete picture of all aspects of system performance.
9.	Benefits of Network Participation	Benefits are proportional to utilization rates.	The greater the need, the bigger the benefits.

6.0 SUMMARY

Building on the findings of a survey of potential users and a descriptive review of five existing information networks, the present study represents an attempt to characterize some of the options for a voluntary confederation of participants in the operation of the National Environmental Data Referral Service (NEDRES) being developed by the Assessment and Information Services Center of NOAA. Concepts from economic theory and general models of information service network configurations were used to help define and evaluate the major trade-off factors. Some of the general propositions that emerged from the examination of the five reference systems include the following:

- The National Water Data Exchange (NAWDEX) is a system that can and should be emulated by NEDRES under the proviso that NEDRES must serve a more diversified clientele.

- Prospective participants will commit themselves to the sustenance of such networks by the execution of formal agreements.

- Users desire both equality of treatment and individualized service. A major challenge to network managers is the reconciliation of these two objectives where they diverge.

- Prospective participants will willingly share assets they already own but are very sensitive to the marginal costs of each transaction.

- Start-up investments such as those associated with promotion and user training should be focused initially on those users who will generate high transaction rates.

- Clear articulation of intended configuration is essential for effective communication to prospective participants--even when it is recognized that the concept will be changed before it is realized as an operational system.

These propositions and others were used in the comparison of a decentralized (Option A) and a centralized (Option B) arrangement. It was discerned that each option had its own unique advantages with a net effect only slightly favoring the decentralized approach. However, by re-emphasizing the pattern of an asymmetrical distribution of needs and capabilities on the part of the potential users, it was possible to show that a hybrid arrangement would not only be favorable but could be more cost-effective than either of the primary options alone. The hybrid arrangement would permit users with intermittant needs and limited capabilities to get support from local service outlets while users with more consistent and intensive needs could be encouraged to mobilize their capabilities toward a more independent and more economical mode of finding and accessing the environmental data stores of value to them. The hybrid configuration was recommended as the best means of achieving an enthusiastic involvement by users and data holders in the long-term sustenance of the NEDRES network.

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APPENDICES

DRAFT

MEMORANDUM OF AGREEMENT

AND THE
UNITED STATES GEOLOGICAL SURVEY
RELATING TO THE USE OF THE GEOLOGICAL SURVEY'S DATA FACILITIES
OF THE
NATIONAL WATER DATA EXCHANGE
AND THE
NATIONAL WATER DATA STORAGE AND RETRIEVAL SYSTEM

This Agreement with the _____ relates to the use of the data facilities of the National Water Data Exchange (NAWDEX) and the National Water Data Storage and Retrieval System (WATSTORE) managed by the United States Geological Survey (USGS), Water Resources Division (WRD). This Agreement will continue in effect until terminated by mutual agreement or by either organization providing 60 days written notice to the other organization.

Definitions:

For the initial purposes of this Agreement, the National Water Data Exchange (NAWDEX) data facilities consist of a Water Data Sources Directory and a Master Water Data Index. The Water Data Sources Directory is a computerized data base which identifies organizations that are a source of water data. The Master Water Data Index is a computerized data base which identifies individual sites for which water data are available, the location of these sites, and the types and frequencies of measurement of available water data. This agreement also applies to the use of any additional NAWDEX data facilities made available in the future.

For the initial purposes of this Agreement, the National Water Data Storage and Retrieval System (WATSTORE) consists of a Station Header File and a Daily Values File. The Station Header File is an automated index of all sites for which data are stored in WATSTORE. It contains information pertinent to the identification, location, and geographic description of each site. The Daily Values File contains water-data parameters measured or observed on either a daily schedule or on a continuous basis and numerically reduced to daily values. This Agreement also applies to the use of any additional files and data facilities of WATSTORE made available in the future.

Both the NAWDEX data facilities and the WATSTORE system are operated and maintained by the Geological Survey on its central computer facilities located at the National Center in Reston, Virginia. These computer facilities are under the management and control of the Computer Center Division, USGS. Therefore, neither NAWDEX nor WATSTORE have administrative responsibilities related to the operation of the computer facilities or the scheduling of computer related services. Also, future additional access to the USGS computer is dependent upon the number of computer terminals that can be physically supported by the computer systems.

Responsibilities:

Related to this Agreement, the Water Resources Division will:

- - - Allow access to the Header and Daily Values Files of the WATSTORE system, the Water Data Sources Directory and Master Water Data Index Files of the NAWDEX system, and application software associated with these files. This will include any additional files and software systems in NAWDEX and WATSTORE that may be made available in the future.

- - - Provide documentation necessary to access and use the NAWDEX and WATSTORE files.

- - - Provide user assistance services as required in the use of the NAWDEX and WATSTORE files and software systems.

- - - Serve as liaison between the _____ and the Computer Center Division in matters related to NAWDEX and WATSTORE.

- - - Provide training in the use of NAWDEX and WATSTORE to the extent possible within budgetary and manpower capabilities.

Related to this Agreement, _____ will:

- - - Acquire all computer-terminal hardware and related peripheral hardware necessary for access to the USGS computer facilities.

- - - Assume full responsibility for all costs associated with the _____ use of the NAWDEX and WATSTORE data files and reimburse the USGS for all costs incurred.

- - - Not use the USGS computer facilities for any purpose other than those related to the use of the NAWDEX and WATSTORE files unless prior agreement has been arranged with the USGS for additional computer usage.

- - - Be identified as a source of water data by the National Water Data Exchange (NAWDEX) and permit all data entered into NAWDEX data files by the _____ to be disseminated to other users upon request.

- - - All data entered into WATSTORE by _____ will, unless password protected, be indexed in the Master Water Data Index maintained by NAWDEX and will be disseminated to other users upon request.

Designated Representatives:

The _____ will designate a principal and one or more alternate representatives at each remote job site to serve as contacts for all NAWDEX and WATSTORE matters.

The Water Resources Division designates as its WATSTORE representative:

Mr. C. R. Showen
Chief, Automatic Data Section
Water Resources Division
U. S. Geological Survey
437 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

Telephone: (703) 860-6871
FTS 928-6871

The National Water Data Exchange designates as its representative:

Mr. Melvin D. Edwards
Program Manager
National Water Data Exchange
U. S. Geological Survey
421 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

Telephone: (703) 860-6031
FTS 928-6031

Cooperation:

In order to successfully develop and maintain the concepts of this Agreement, an open exchange of information relative to NAWDEX and WATSTORE, their functions and operations, will be established between the _____ _____ and the USGS, WRD.

_____ _____
Signature, Title Signature, Title

Date _____ Date _____

MEMORANDUM OF UNDERSTANDING

_____

AND THE
UNITED STATES GEOLOGICAL SURVEY
PERTAINING TO THE NATIONAL WATER DATA EXCHANGE

The National Water Data Exchange (NAWDEX) is comprised of water-oriented organizations working together to provide convenient access to water data. The NAWDEX mission is to identify sources of water data, to index data holdings of water-oriented organizations, and to provide the linkage between those who acquire and those who use water data.

This memorandum recognizes _____ as a participating member of the National Water Data Exchange (NAWDEX). This membership will continue in effect until terminated by mutual agreement or by either agency providing 60 days written notice to the other agency.

The U. S. Geological Survey (USGS), through its NAWDEX Program Office, will provide the central management of NAWDEX, and will serve as a coordinating facility for all NAWDEX facilities.

The NAWDEX Program Office will be responsible for:

- - - Establishing response and referral mechanisms for handling requests for water data in the files of NAWDEX members.

- - - Establishing and maintaining a Master Water Data Index of data holdings of the NAWDEX members and making the index available to all.

- - - Establishing and maintaining a Water Data Sources Directory and making this directory available to all.

- - - Establishing a nationwide network of NAWDEX Assistance Centers that will provide data search assistance to requesters and aid them in gaining access to water data held by NAWDEX members.

_____ will be responsible for:

- - - Taking an active role in the formulation of NAWDEX policies, procedures, and standards and implementing them within its organization to the extent practicable.

- - - Participating in the development of standard techniques and methodologies for handling of water data and using them within its organization to the extent practicable.

- - - Providing information on internally held water data for inclusion in the Master Water Data Index and, as requested, providing current information to update the Master Water Data Index to reflect additions, changes, and corrections to the index.

- - - Providing data from its internal holdings either in response to a referral from the NAWDEX Program Office or a NAWDEX Assistance Center, or in response to a direct request for water data.

- - - Designating a representative of its organization to function as the primary contact for all NAWDEX matters.

It is mutually understood that membership in NAWDEX is voluntary and that all members will participate on an equal basis, and consent to be listed as a source of water data in the Water Data Sources Directory. There will be an open exchange of information among NAWDEX members and every effort will be made to provide water data to the user community in a timely and equitable manner.

_____
Signature, Title

Date _____

_____
Signature, Title

Date _____

GUIDELINES FOR USER CHARGES WITHIN THE NATIONAL WATER DATA EXCHANGE

INTRODUCTION

Assistance Centers are operated in 45 States and Puerto Rico as a part of the program of the National Water Data Exchange (NAWDEX) for assisting users of water data in identifying, locating, and acquiring needed data. In addition, many NAWDEX member organizations provide water data and related services in response to public requests and referrals from the Assistance Centers. Because of the wide diversity in the types of organizations (Federal, State, interstate, local governmental, academic, and private) providing these data and services, there are significant differences in the policies and procedures concerning user charges. These differences create a need for guidelines to be used by the membership for applying user charges in a more uniform and equitable manner throughout the program.

THE GUIDELINES

The following are general guidelines for the determination and application of user charges within NAWDEX:

- Providing data and information is a proper "service function" of government and research institutions, and water data and related services should be made available at the lowest cost possible to the user.

- User charges assessed by NAWDEX members should cover only those costs directly incurred by responding to the requests for data.

- As a general rule, user charges should not include personnel time of permanent staff, overhead costs, equipment amortization, or other fixed costs for services and products made uniformly available to all NAWDEX users.

- Special attention should be given to assessing charges for government, nonprofit and academic users as discussed below under "Suspension of Charges."

- Billing procedures for data and services should be simple and low-cost so as not to increase user charges.

These guidelines do not mandate specific procedures for use, rather, they are presented as objectives to be considered by members in developing user charges.

DETERMINATION OF CHARGES

To a large extent, the factors controlling the determination of charges is fixed by governmental and corporate policy. Federal agencies are required to adhere to the directives of Circular Number A-25 as issued by the Office of

privilege) provides special benefits to an identifiable recipient above and beyond those which accrue to the public at large, a charge should be imposed to recover the full cost to the Federal Government of rendering that service." It further defines that "a special benefit will be considered to accrue that a charge should be imposed when a Government-rendered service:---is performed at the request of the recipient and is above and beyond the services regularly received by other members of the same industry or group, or of the general public." All Federal members of NAWDEX should carefully review their procedures for determining and assessing charges to assure that they comply with Circular A-25. All other members should also review their organizational policies related to these matters to assure legal compliance. Also, all governmental members should verify that proper enabling authorities exist for the collection of funds for services rendered to the public.

The items discussed below are considered to be the types of valid charges which may be used in determining costs associated with a request of response transaction:

Personnel: In general, charges should be considered only for personnel directly involved in responding to a specific request for data or services. Personnel charges should not be considered for products and services made uniformly available to all NAWDEX users. Personnel charges may include direct salaries and the cost of employee benefits proportionate to the time spent responding to a request.

Material Provided: Charges may be considered for the actual cost of materials which must be provided in response to a request. Examples of such materials would be magnetic tapes, notebook binders, special containers, punch cards, and other items which must be purchased by the responding organization in order to satisfy a request.

Duplication Costs: The cost of duplication of printed material may be computed at the actual cost of duplication per page or other unit. This includes the cost of photocopy, offset printing, and reproduction from microfilm or microfiche. The duplication of data in machine-readable form may be covered as computer costs, which are discussed later, unless the duplication is performed on peripheral hardware that is not included in an organization's standard computer charges and reimbursements must be made for its use. This includes punch-card duplicators, offline plotters, and printers.

Computer Related Costs: Charges may be considered for all computer costs associated with the retrieval, processing, and analysis of data or information associated with a request. This includes costs associated with use of the central processing unit, input/output transactions, core (memory) charges, connect time, and the use of peripheral equipment such as plotters, card punches, and microform equipment. If computer costs are computed on a variable scale based upon the priority of use of the computer, the requestor should be made aware of this in order to assure that the required product or service is provided at the minimum cost.

Telecommunication Charges: Charges may be considered for telecommunication costs directly associated with responding to a request. This includes line

(telephone) charges resulting from the remote use of computers and the transmission of data by facsimile or other types of transmission equipment.

Cost Incurred from Other Sources: Charges may be applied for costs assessed to the responding organization by other sources in the course of responding to a request. This includes computer costs charged by other sources, service fees paid to another organization, the cost of publications acquired from other sources, and any other action that results in a direct assessment to the responding organization.

Mailing Costs: Mailing costs other than normal postage may be considered. This includes air freight, special-handling fees, and courier services.

The determination of user charges can be a difficult, complex process. However, each organization should take care to assure that the determination of charges is done in a manner that offers minimum cost and fairness to all requestors regardless of the size or complexity of a request.

No effort has been made to establish prices in these guidelines. Because of the wide variability of cost between organizations, the establishment of charges must remain the responsibility of each responding organization. Each organization should, however, make its fee schedules freely known and available and should be prepared at all times to provide realistic estimates of the costs of its generated products and services.

SUSPENSION OF CHARGES

There are several situations where the suspension of user charges may be considered by a responding organization. Some of these, as outlined by the Office of Management and Budget, Circular A-25, include:

- The cost of recovery of charges is greater that the amount to be assessed. For example, many organizations establish an amount, such as $15, below which it has been determined that the administrative costs of processing a bill of collection and the processing of receipts is greater than the receipts received.

- The furnishing of the service without charge is an appropriate courtesy to a foreign country or international organization.

- The recipient is engaged in a nonprofit activity designed for the public safety, health or welfare.

- Payment of the full fee by a State, local government, or nonprofit group would not be in the interest of the (providing) program.

Others, not defined by Circular A-25, include:

- Reciprocal arrangements exist between organizations for the mutual exchange of data, information, or services.

- Provision of the product or service is determined to be of direct benefit to the providing organization.

- Formal agreements exist between the two parties which prohibit the assessment of fees.

CONCLUSION

The assessment of user charges is a process that is often mandated by controlling laws, rules, and regulations. User charges should, therefore, be developed with close attention to all such requirements. As previously stated, NAWDEX has no authority to mandate policy or procedure relating to user charges, nor does it have the authority to negate or supercede any existing law or regulation. The guidelines presented in this paper can, however, be used for the application of user charges within NAWDEX in a consistent and equitable manner.